TRANSACTIONS

OF THE

AMERICAN

FISHERIES SOCIETY.

TWENTY-FIRST ANNUAL MEETING.

HELD IN THE HOLLAND HOUSE, N. Y. CITY.

MAY 25TH, 1892.

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MINUTES

OF THE

TWENTY-FIRST ANNUAL MEETING

OF THE

AMERICAN FISHERIES SOCIETY,

HELD IN THE

CITY OF NEW YORK,

WEDNESDAY, MAY 25TH, 1892,

AT THE HOLLAND HOUSE.

PART FIRST.

THE FOLLOWING MEMBERS WERE PRESENT:

F. J. Amsden,	Rochester, N. Y.
L. D. Huntington,	New Rochelle, N. Y.
Dr. Tarleton H. Bean,	Washington, D. C.
James Benkard,	New York City.
Prof. A. S. Bickmore,	New York City.
Henry Burden,	Troy, N. Y.
W. A. Butler, Jr.,	Detroit, Mich.
Dr. H. H. Carey,	Atlanta, Ga.
Frank N. Clark,	Northville, Mich.
William A. Conklin,	New York City

Fred Mather,	Cold Spring Harbor, N. Y.
E. P. Doyle,	New York City.
J. F. Ellis,	Washington, D. C.
N. K. Fairbank,	Chicago, Ill.
Henry C. Ford,	Bay City, Mich.
Asa B. French,	South Braintree, Mass.
John Gay,	Washington, D. C.
W. L. Gilbert,	Plymouth, Mass.
G. Brown Goode,	Washington, D. C.
J. E. Gunckel,	Toledo, O.
Charles F. Imbrie,	New York City.
Dr. Bushrod W. James,	Philadelphia, Pa.
W. L. May,	Omaha, Neb.
Col. M. McDonald,	Washington, D. C.
W. F. Page,	Washington, D. C.
Dr. J. C. Parker,	Grand Rapids, Mich.
Hoyt Post,	Detroit, Mich.
W. L. Powell,	Harrisburg, Pa.
R. Redmond,	New York City.
Chas. B. Reynolds,	New York City.
Hon. Geo. M. Robeson,	Camden, N. J.
William P. Seal,	Washington, D. C.
L. Streuber,	Erie, Pa.
Herschel Whitaker,	Detroit, Mich.
J. D. Quackenbos,	New York City.
W. S. Webb,	New York City.
John H. Titcomb,	Rutland, Vt.
C. C. Warren,	Waterbury, Conn.
W. H. Rogers,	Amherst, N. S.
Daniel Morrell,	Hartford, Conn.
Chas. F. Orvis,	Manchester, Vt.
J. F. Merrill, Ph. D.,	Albany, N. Y.
Dr. E. Bradley,	New York City.
J. W. B. Hughes,	New York City.
J. W. Hoxie,	Carolina, R. I.
W. H. Bowman,	Rochester, N. Y.
Charles F. Chamberlayne.	Buzzard's Bay, Mass.
David G. Hackney,	Fort Plain, N. Y.

In the absence of Dr. James A. Henshall, President of the Society, Dr. James C. Parker, Vice-President, presided.

Letters of regret at their inability to attend were read from J. C. Bottemantle of Holland; Dr. James A. Henshall, Washington, D. C.; Hon. E. D. Potter, Toledo, O.; A. Nelson Cheney, Glens Falls, N. Y., and C. Zweighaft, Philadelphia, Pa.

The secretary read a communication from the New York Society for the Protection of Fish and Game, requesting the presence of the members at a dinner to be given at the Holland House, Wednesday evening, May 25th, and on motion the invitation was accepted and the secretary directed to express to the President of the Society for the Protection of Fish and Game the thanks of the American Fisheries Society.

The secretary also read an invitation from Mr. Roland Redmond, President of the South Side Club, to visit the preserves of the Club on Long Island on Thursday, May 26th, members to go by special train leaving Long Island City at 9.30 in the morning.

On motion, the invitation was accepted, and the secretary was directed to write to the President of the South Side Club thanking him for his courtesy.

Mr. Henry C. Ford of Philadelphia, Pa., then presented his annual report as Treasurer of the Association. The report is as follows:

AMERICAN FISHERIES SOCIETY
IN ACCOUNT WITH
HENRY C. FORD, Treasurer.

1891.	CREDITS.	DEBITS.	CREDITS.
May 26.	By cash, balance on hand....		$ 98.87
1892.			
May 24.	" Members' dues, received.....		324.00
			$422.87

DEBITS.

1891.			
May 28.	To cash paid time of omnibus at Washington....	$ 7.00	
June 15.	To cash Spangler & Davis, printing bills.....	1.00	
July 30.	To cash Mary Walling, type-writing report.....	4.75	
" 30.	To cash Photo-Engraving Co.....	7.00	
" 30.	To cash 100 stamped envelopes.....	2.16	
Aug. 8.	To cash E. P. Doyle, new circulars.....	9.16	
" 12.	To cash expressage on circulars to Philadelphia..	1.00	
" 12.	To cash expressage on circulars to Egypt Hills..	.80	
" 12.	To cash 100 stamped envelopes.....	2.16	
" 12.	To cash John M. Davis, printing report.....	124.20	
" 31.	To cash E. P. Doyle, sundry expenses.....	22.75	
Sept. 3.	To cash stamped envelopes.	2.16	
1892.			
Jan. 29.	To cash E. P. Doyle, sending out circulars.....	15.00	
" 30.	To cash F. Richardson, sending out circulars....	6.00	
May 24.	To cash balance on hand..	217.73	
		$422.87	$422.87

Philadelphia, May 24th, 1892.

E. O. E. H. C. FORD.

On motion of Dr. Carey of Georgia, the report was referred to a Committee of Three, consisting of H. H.

Carey of Georgia, Hoyt Post of Michigan, a . Amsden of New York, for audit.

The secretary then presented the report for ast year. The report was received and ordered filed. It is as follows:

May 25th, 1892.

To the President and Members of the American Fisheries Society.

Gentlemen:

I have to report that during the year past 4 members of the society have died, 4 resigned, and 43 new members elected. The present membership is:

Corresponding, - - - - - -	27
Honorary, - - - - - -	6
Active, - - - - - -	220

The committee appointed at the last meeting to endeavor to increase the membership of the society have done a great deal of work, but the results have been rather meagre. Circulars were sent to hundreds of sportsmen throughout the country, but only about thirty responded. The only way in which the membership can be materially increased is by the personal solicitation of our members. I would urge that each member feel himself specially charged with securing as many new members as possible, so that the society may make a good showing at Chicago in 1893.

Many of the new members obtained this year were obtained through the efforts of Mr. Cheney, and much credit is due him for his work.

The society is in a more prosperous condition than ever before, and there is no reason why its ultimate success as a powerful and influential organization should not be assured.

Very respectfully,

EDWARD P. DOYLE,

Secretary.

Mr. W. L. May of Nebraska, moved that a Commit-

tee of Three be appointed to nominate officers for the society for the ensuing year.

The motion was carried, and the president appointed as such committee, W. L. May of Nebraska; H. H. Carey of Georgia, and William A. Butler, Jr., of Michigan.

The reading of papers then began and continued until adjournment, which was taken until 2 o'clock of the same day.

Minutes of adjourned meeting: Meeting called to order at 2.15 o'clock.

Mr. May, from the committee appointed for the purpose, reported the following nominations for officers for the society for the ensuing year. The report is as follows:

To the Officers and Members of the
American Fisheries Society:

Your committee appointed to nominate officers for the ensuing year, respectfully recommend that the following be elected to fill the respective offices for which they are named:

President, Herschel Whitaker, Detroit, Mich.
Vice-President, Fred. Mather, Cold Spring Harbor, N. Y.
Treasurer, Henry C. Ford, Philadelphia, Pa.
Rec. Secretary, E. P. Doyle, New York City.
Cor. Secretary, Tarleton H. Bean, Washington, D. C.
Executive Committee,
H. H. Carey, La Grange, Ga
William H. Bowman, Rochester, N. Y.
L. Streuber, Erie, Pa.
William M. Hudson, Hartford, Conn.
N. K. Fairbank, Chicago, Ill.
C. V. Osborn, Dayton, O.
B. P. Porter, San Francisco, Cal.

W. L. May,
Wm. A. Butler, Jr., } *Committee.*
H. H. Carey,

On motion and by unanimous consent, the report of the committee was adopted and the officers named elected

The question of the selection of a place for the next meeting of the society was then brought up, and on motion it was unanimously decided to hold the next meeting of the society in Chicago, on the second Wednesday of August, 1893.

The secretary read an invitation from J. W. Collins, Chief of the Department of Fish and Fisheries at the World's Fair, tendering the use of the Fisheries Building for the meeting of the society.

He also read an invitation from the Michigan World's Fair Commissioners, tendering the use of the Michigan Building for the same purpose.

On motion, it was ordered that the invitations be referred to the Committee on Local Entertainment when appointed, and that the secretary acknowledge their receipt.

Mr. May then moved that a Committee of Five on Local Entertainment be appointed from the States nearest Chicago.

Motion was carried, and the committee was appointed as follows:

Wm. L. May, Omaha, Neb.
Calvert Spensley, Mineral Point, Wis.
Wm. A Butler, Jr., Detroit, Mich.
J. E. Gunckel, Toledo, O.
S. P. Bartlett, Quincy, Ill.

Mr. Hoyt Post of Michigan, moved the following resolution:

"*Resolved*, That this society regards with disfavor any "movement looking towards the turning over to the "United States Government the work of the said com- "missions in propagating and planting fish and in the "regulation and protection of the fisheries in the several "States. That the jurisdiction over fisheries within the

"territorial boundaries of each State belongs naturally to "that State. That there is an abundant field for the co- "operative action of the State, and of the general gov- "ernment in the propagation and distribution of food "and game fish and anything which would detract from "the State's interest in this respect will be detrimental "to the end aimed at of restocking the waters of this "country, and we recommend a course which will "encourage and stimulate greater interest and larger "expenditures in this great work by the several States, "and at the same time increased interest in the matter by "the United States. And be it further

"*Resolved*, That the purposes and aims of this society "are in direct antagonism with any business which tends "to the depopulation of the waters to enrich the land, "we therefore condemn purse seining of menhaden or "of any fish food or food fish for the purpose of grind "ing the same into guano or oil."

A division of the question was asked for, and the first resolution was adopted and the second laid on the table until the next meeting.

Mr. James Benkard moved the appointment of a committee to prepare resolutions expressing the grief of the society at the sudden death of ex-President George Shepard Page.

The committee appointed was as follows:

James Benkard, Fred, Mather, W. L. May.

The following named gentlemen were then unanimously elected active members of the society:

Archibald Mitchell,	Norwich, Conn.
E. W. Leavenworth,	Wilkesbarre, Pa.
Geo. T. Mills,	Carson City, Nev.
A. G. Hall,	Reeds Creek, N. Y.
W. S. Gavitt,	Lyons, N. Y.
T. E. Krumbholtz,	Wawbeek, N. Y.
Saranac Lake Hotel Co.,	Saranac Inn, N. Y.
Witherbee W. C.,	Port Henry, N. Y.

F. J. Anderson, - - - Whitestone, N. Y.
B. F. Van Valkenburg, - - New York City.
A. Booth Packing Co., - - - Chicago, Ill.
S. Zweighaft, - - - Philadelphia, Pa.
R. W. Jones, - - - - Syracuse, N. Y.
G. S. Klock, - - - - - Rome, N. Y.
Henry G. Preston, - - - Brooklyn, N Y.
J. D. Quackenbos, - - Columbia College, N. Y.
W. S. Webb, - - - - New York City.
John N. Titcomb, - - - - Rutland, Vt.
Joseph O. Miller, - - - Mt. Kisco, N. Y.
Edward F. Brush, M. D., - - Mount Vernon, N. Y.
C. C. Warren, - - - - Waterbury, Vt.
E. W. Adams, - - - 110 Wall St., N. Y.
James Yalden, - - - - 11 Pine St., N. Y.
Geo. W. Upston, - - - Warren, Ohio.
J. A. Powers, - - - Lansingburg, N. Y.
J. H. Offensend, - - - Fair Haven, Vt.
F. W. Ayers, - - - - - Bangor, Me.
W. H. Rogers, - - Amherst, Nova Scotia.
Alex. Taylor, Jr., - - Mamaroneck, N. Y.
Jas. A. Greuseback, - - New Rochelle, N. Y.
John Q. Underhill, - - New Rochelle, N. Y.
Daniel Morrell, - - - Hartford, Conn.
E. G. Whitaker, - - - New York City.
Chas. F. Orvis, - - - Manchester, Vt.
Robert Lenox Banks, - - - Albany, N. Y.
T. H. Foulds, M. D., - - Glens Falls, N. Y.
H. S. Buell, - - - - Albany, N. Y.
F. J. Merrill, Ph D., - - Albany, N. Y.
E. Bradley, M. D. - - - New York City.
D. W. B. Hughes, - - - New York City.
Samuel Garman, - - - Cambridge, Mass.
Heber Bishop, M. D., - - Boston, Mass.
J. W. Hoxie, - - - - Carolina, R. I.
W. H. Bowman, - - - Rochester, N. Y.
Chas. F. Chamberlayne. - - Buzzards Bay, Mass.
David G. Hackney, - - Fort Plain, N. Y.

Fred Mather,	Cold Spring Harbor, N. Y.
Robert Hamilton,	Greenwich. N. Y.
Wm. F. Balkam,	Rochester, N. Y.
Dr. Bushrod W. James,	Philadelphia, Pa.

On the proposition of G. Brown Goode, Dr. Decio Vinciguerra, University of Rome, Italy, was elected a corresponding member.

On the proposition of Mr. A. R. Cheney, Mr. Thomas Andrews, Westgate House, Guilford, England, was elected a corresponding member of the society.

The reading of papers then continued until adjournment.

The titles of the papers read during the entire session, morning and afternoon, were as follows:

"Fish and Fishing in Ohio," J. E. Gunckel, Toledo.

"Planting Fry *vs.* Planting Fingerlings," James Nevins, Madison, Wis.

"Food for Fishes," A. N. Cheney, Glens Falls, N. Y.

"The Present Status of Trout Culture," William P. Seal, Washington, D. C.

"American Salmon and Other Food Fishes," Dr. Bushrod W. James, Philadelphia, Pa.

"Feeding Trout Fry," Fred Mather, Cold Spring Harbor, N. Y.

"The Susquehanna; Past, Present and Future," A. F. Clapp, Sunbury, Pa.

"Rearing Trout for Distribution," Frank N. Clark, Northville, Mich.

"Fry *vs.* Fingerlings," Herschel Whitaker, Detroit, Mich.

"The Past and Future of Fishculture; Or, a Historical Glance at the Cultivation of the Waters," M. Raveret Wattel, Paris, France.

"Historical Review of the Fisheries of the Great Lakes," Herschel Whitaker, Detroit, Mich.

"State Control of State Fisheries," Hoyt Post, Detroit, Mich.

"Artificially Reared Trout," W. L. Gilbert, Plymouth, Mass.

"National Salmon Park," Livingston Stone, Charlestown, N. H.

"Fish-ways," W. H. Rogers, Amherst, N. S.

"The Eggs of the Rainbow Trout," W. F. Page, Neosho, Mo.

"Naturalization of Fisheries," Chas. F. Chamberlayne, Buzzards Bay, Mass.

These papers and the discussion they excited will be found in full in part two of the proceedings.

Minutes of an adjourned meeting of the American Fisheries Society, held in the parlors of the South Side Club, Oakdale, Long Island, Thursday, May 26th, 1892. Meeting called to order at 11 o'clock.

On the proposition of W. F. Page, Mr. E. Chazari, No. 11 Arco de San Augustine, City of Mexico, was elected a corresponding member of the society.

Upon motion of Mr. Hoyt Post, the following resolution was unanimously adopted:

"*Resolved*, That the several Fish Commissioners of "the United States be and hereby are by virtue of the "offices they hold, declared members of the American "Fisheries Society, And be it further

"*Resolved*, That the Secretary write to such Commis-"sioners at once, informing them of the aims of the "society, and request their acceptance of membership."

The resolution regarding purse nets laid on the table at the last meeting, then came up and after considerable discussion, participated in by Col. McDonald, Geo. M. Robeson, L. D. Huntington, Hoyt Post, Herschel

Whitaker and others, the resolution was amended and unanimously adopted.

The resolution as amended is as follows:

"*Resolved*, That the purposes and aims of this society "are in direct antagonism with any business which leads "to the depopulation of the waters to enrich the land "and we therefore condemn purse seining of menhadan "or any fish food or food fish for the purpose of grinding "the same into guano or oil, within three miles of the "shore at low water mark."

On motion and by unanimous consent, the secretary was directed to write the several fish commissioners of the United States, requesting that each board of commissioners delegate one of its number to prepare a historical review of the work of the respective commissions since their creation, to be read at the Twenty-second Annual Meeting of the society in Chicago, in 1893.

On motion, the following resolution was unanimously adopted:

"*Resolved*, That the thanks of the American Fisheries "Society are hereby extended to the New York Society "for the Protection of Fish and Game, for the entertain- "ment given the society, and to the South Side Club for "the courtesy extended at their club preserves on Long "Island. And be it further

"*Resolved*, That the thanks of the society be tendered "to the management of the Holland House for the use "of the rooms in which the meetings of the society have "been held, and for other courtesies extended. And be "it further

"*Resolved*, That the New York Society for the Pro- "tection of Fish and Game and the South Side Club be "made honorary members of this society."

Meeting then adjourned *sine die*.

EDWARD P. DOYLE,

Recording Secretary.

PAPERS READ BEFORE THE

American Fisheries Society,

WITH THEIR DISCUSSIONS,

MAY 25TH, 1892.

PART SECOND.

FISH AND FISHING IN OHIO.

By John E. Gunckel.

For 200 miles within the boundary lines of Ohio the blue waters of Lake Erie dash against rocky cliffs, mingle with tributary rivers or peacefully roll over long stretches of white sandy beach. This great open expanse in early days abounded in food fishes. The choicest were only selected of the now twenty species eagerly sought after. The few inhabitants found the supply more than sufficient for their needs; and indeed it seemed practicably inexhaustible. But as the population increased and industries became diversified, men gradually came to take fish to meet the demand of those living at a distance from the water, making what had hitherto been an occasional occupation, a regular means of livelihood—an industry. Here began the unequal struggle between the inhabitants of the land and water in which was foreseen the inevitable result of the virtual extinction of the weaker creatures. In addition to what then seemed to be wise legislation for the protection of fish, the science of fishculture came to the relief, and it was then seen

that man was to be used as an instrument to prevent the extinction of the species of food fishes in our inland waters. In the fall of 1875 the first governmental efforts were made to hatch whitefish. The parent fish were first obtained, the eggs extracted and fertilized, and it is a fact that almost every egg was safely hatched and the young deposited in the waters of Lake Erie. From that date to the present time the State, through its efficient Commission, has deposited in Lake Erie 400,000,000 of young whitefish. Since the spring of 1880 upward of 200,000,000 of pickerel have been hatched by the Commission, and deposited in Ohio waters suitable for them; and from the last official report, dated May 16, 1892, out of four hundred quarts of pickerel spawn sixty per cent. was hatched. Not only do people living along the lake shore find almost daily supply of food, fishes for consumption in a fresh state, but by proper methods of preparation and preservation the product of the lake is fitted for long continued keeping and transportation to distant markets where fishing is difficult, impracticable or impossible. With able legislation and increased assistance of the Fish Commissioners the supply of food fishes does not equal the demand, and the fisherman's cry, from shore to shore, is the scarcity of favorite fishes, and each year the perfected net appliances increase. Closer and closer are the spawning grounds limited, deeper and longer are the gill-nets and smaller the meshes until whitefish the size of herring are taken from the deepest waters. Back in the seventies sturgeon were so plentiful and useless that hundreds were daily thrown out of the nets back into the water. To-day nearly every part of the fish is utilized and the net fisherman is fortunate who captures four or five in his daily catch. Again the fishculturist is heard from and he introduces methods of artificial hatching, and it is estimated that 80 per cent. of the young sturgeon released in the waters live to take care of themselves—so hardy

and capable of self-defense and self supporting are the fry. I have the pleasure of personally knowing many of Ohio's foremost fishculturists who have spent years in propagating fish, studying and becoming familiar with the habits and devising ways and means to check the rapid decrease and to replenish depleted waters. Many of the commercial fishermen appreciate and recognize their efforts, and while the fishermen are gradually covering, with killing nets, nearly all the territory where fish visit—for scarcity of fish means more twine—they cheerfully suggested plans and ideas to aid those who are so deeply interested in preserving our food fishes.

The following notes of interest I have gleaned from wholesale fishermen along the various lake ports. Of whitefish, ten out of sixteen fishermen believed that twelve per cent. of the fish deposited in the lake by the Commission were captured with gill nets before they reached one pound in weight in the deep water off the Pennsylvania shore. Twenty per cent. lived to maturity, and this could be increased fifteen per cent. more if the young fish were treated like we raise little pigs—deposited in pens in suitable water around the islands until old enough to take care of themselves In 1857, on the south shore of the lake, during almost every strong northeastern gale the spawn of whitefish was cast up on the beach in such immense quantities it was often strewn to the depth of 2 or 3in., several feet wide, for miles along the shore. The general complaint, although reluctantly admitted, is that the meshes of the rapidly increasing gill nets are too small, they are destroying whitefish weighing less than 1lb., while the leaders of the pound nets are increasing to such an alarming extent as to seriously interfere with navigation, let alone keeping back the fish en route to their spawning grounds. All fishermen agree that the natural spawning grounds of the lake are at the mouth of the Detroit River. Whitefish, pickerel, bass, saugers, sturgeon and other food fishes pay annual visits to this

point; the pickerel depositing their eggs as they pass up the river, paying no attention to hatching or caring for their young. Sturgeon are caught while rolling around their spawning beds, or guarding their young. The bed of the river and following the channel far into the lakes is literally alive with suckers of all sizes and kinds. There is no spot on the chain of lakes equal to this clear, rapid river for small-mouthed black bass and other game fish to spawn and thrive. The flavor of fish caught in this magnificent body of water is world known. It is also an admitted fact, and well known by the writer, that the channel in Sandusky Bay, winding, as it does, through a broad expanse of shallow water, is the best protected body of water along the lake shore, and while other bays and tributary rivers formerly abounded with the beautiful white bass and are now almost extinct, this channel leading up the Sandusky River is alive with this clean-looking fish from June until late in the fall; and further inland, among the bends and narrow channels lined with blooming lilies, can be found in great numbers the finest large-mouthed black bass grounds in the world. Referring to pickerel, bass and other food species, the majority of fishermen agree that all channels leading to and from the lake through the bays and rivers proper should be kept clear of nets particularly in the spawning seasons, for eventually the net fishermen must be actually benefited by allowing a large number of fish to cast their spawn in waters above the roving egg-destroying marauders, for as the country with its drainage toward the lake is being tilled to an extent beyond belief the creeks and rivers rise so rapidly and so high that fish are found in great quantities in ditches miles inland from the lake.

While the general public believe that unless some decided and effective measures are adopted to enable a large number of fish to safely reach their spawning grounds, there is great danger of extermination of our

lake food fishes; and while many of our commercial fishermen oppose protective legislation mainly because they object to any laws which shall limit their ability to take all the fish possible from a given water area in a given time, the thoughful fishermen express a willingness to co-operate with legislative enactments looking to thorough preservation of fish. My attention has been frequently called to the fact that there is no legislation on the statute books of Ohio which offers any protection to the game and food fish of Lake Erie during the spawning season. Any attempt at such legislation is met by the organized opposition of the men who wrongfully imagine that their private interests are thereby attacked, and who have been able thus far to prevent the passage of many measures that would have materially benefited them in the end. On the other hand, most men do not care to expend time and money in urging a species of legislation from which they are to reap only an indirect and remote advantage. Neither for the same reason do they incline to aid in securing a thorough and impartial enforcement of such laws as already exist. Many believe in restriction as to the seasons and methods of taking fish, but they are unwilling to act as either prosecutors or witnesses when such laws are violated. In this connection I might add that in all legislative action taken, whether by national or State governments, care should be taken to properly define what constitutes the waters of the lakes and inland waters. One of the most prolific causes of misunderstanding as to the meaning of various laws now passed has been the claim made by some that the waters of the lake extended up the rivers as far as tide water; it will thus be seen that the efforts to protect the rivers are paralyzed by having their mouths filled with nets. Another trouble is the lack of uniformity of the laws in adjoining States, thus in Ohio some of our best streams are fully protected against destructive net fishing, while their mouths, emptying into the lake in an

adjoining State, are completely blockaded with nets, the nets even extending from either shore across the channels. Uniformity would give a clearer comprehension as to the meaning of the law in both States.

Another serious difficulty in the enforcement of existing laws is that the officials to whom such enforcement is committed are left without fixed adequate compensation for their services. An Ohio fish warden receives no remuneration, and even his time and labor in securing an arrest and prosecution are wholly unremunerated unless he secures a conviction. We need most of all to educate the people into a broader and fuller appreciation not alone of the rights of others but of their own interests. We shall succeed in this work when we make the general public comprehend that in protecting the rights of others in the fish of our open waters we are in reality preserving our own, Relative to interior fish and fishing the subject is one of such vast interest that it would require another paper much longer than this to do it justice. It is generally believed that the laws are better observed than along the lake shore; that game fish are increasing and the people are in sympathy with the commission and appreciate their labors. With the Ohio State fish car, the Buckeye, the commission has deposited some twelve thousand black bass, weighing from a half to three pounds in the rivers and creeks throughout the State.

I could hardly close without a word about our rod and line fishermen. There seems to be implanted in the nature of every Buckeye angler the love of outdoor sport; they recognize fishing as the keenest of enjoyments. While it is the common destiny of mankind to labor from the cradle to the grave, toil and hardship are brightened by and often endured for, the prospect of angling, with its anticipated hopes, fears and pleasures. I can say from a personal experience that the desire to kill and destroy is more a potent motive, with our rod fishermen, than a necessity. It is a conceded fact that Ohio contains more

truthful anglers than any State in the Union the city of Toledo leading. I will relate an incident narrated recently to me by that venerable fisherman, Hon. Emery D. Potter, illustrating the pleasure of fishing with hook and line in Ohio, under favorable circumstances. "Among the many pleasant incidents of hook and line fishing," said the judge, "and one of the most successful afternoon outings I ever experienced, was in the year 1863, with Dr. Theodatus Garlick of Cleveland, Ohio. The doctor was a great hunter and frequented the marshes at the head of Lake Erie. One afternoon when hunting was poor I persuaded him to accompany me in a boat to try his luck at fishing. He accepted and we anchored in one of the many guts around Gard Island, and began casting for black bass. We fished thirty minutes and succeeded in landing thirty-two bass, the largest weighing four, the smallest two pounds. A fair afternoon's fishing. In reply to my question, to the doctor, the next day 'to go a-fishing,' he looked very serious and said, 'Well, judge, having no use for the fish I am honestly ashamed to fish for the fun of it.'"

FOOD FOR FISHES.

By A. Nelson Cheney.

As a rule fishermen give themselves little concern about the food supply of the fishes which they delight to capture with rod and reel, with fly and bait. If a trout as it is taken from the landing-net is found to be plump and well fed, the fact is noted as it is placed on a bed of ferns in the creel; and so, too, when a trout proves to be gaunt and lean its condition is commented upon, but not one angler in a hundred ever thinks of making the least effort to supply food which will enable the gaunt, lean fish to become plump and well fed.

Nearly ten years ago I prepared a paper upon the subject of Food Fish and Fish Food, which was read before this society. Since that time great strides forward have been made in all branches of the science of fishculture, and fishermen are reaping the benefits; but to-day, outside of fishcultural establishments, the subject of supplying the ever-increasing output of fish with an abundance and variety of food receives little if any more attention than it did then. This is a matter in which fishermen, if they are inclined, can render valuable aid to the hatcheries and fish-breeding establishments that are planting fish in public waters.

I am of the opinion that there may be many anglers throughout the land willing to render assistance in increasing the food supply of fishes in waters not within the direct influence of the National or State Fish Commissions, if they could know how to go about it, and at the same time know what a simple matter it is to furnish a diversity of food to fishes that from natural causes may be restricted in their diet. Primarily, I address the anglers, but the subject is so broad a one that in applying the suggestions that I shall make, others may be interested. As an example of stocking water with fish food not native to it, I may cite a lake in the State of New

York, which is thirty-six miles long and from one to two and one-half miles wide, that was planted with 18,000 crayfish in 1878. The plant was made in two or three streams at one end of the lake, and for several years past the crayfish have been found in abundance from one end to the other of the thirty-six miles of water. A form of fish food that I have been and am specially interested in is the fresh-water shrimp, *Gammarus fasciatus* of Say, or perhaps more frequently called *Gammarus pulex*. We have three species of *Gammarus* in our ponds, brooks and rivers, and Prof. S. I. Smith says of them: 'They probably breed throughout the spring and summer, as females taken at various times from March to August are found carrying eggs or young in various stages of development." He infers that, as species allied to the *fasciatus* develop rapidly, they breed several times each season. When trout are found to have dark-red flesh with cream-like curds between the flesh flakes, it is a sure sign that the waters they inhabit produce crustacean food in abundance.

I have transplanted shrimp in trout streams with the best results, but never have tried them in ponds. Caledonia Spring Creek. on which one of the hatching stations of the New York Fish Commission is situated, is famous the country over for its well-conditioned trout and its abundance of fish food. The Castalia stream in Ohio is similar in character to Caledonia Creek, and the fish food in many respects is identical because of transplanting mosses and water weeds with accompanying insect and crustacean forms of life from the latter to the former. Prof J. A. Lintner examined a can of mosses and aquatic plants sent to him from Caledonia Creek after "his attention had been called to the remarkable abundance of trout in the stream, abounding, it was believed, as in no other natural locality in the United States."

When the can was opened the mosses and plants swarmed with insect larvæ and crustaceans to such an

extent that he could not believe that it was a fair representation of the fauna of the creek, and wrote to know if other animal life than that which naturally accompanied the plants had not been placed in the can, but none had been introduced except those contained in the plant when gathered. Shrimp were so numerous in the moss that one could not raise a handful of it without noticing the very large number of these creatures present. The water from the can was poured into an aquarium and at once "numerous examples of the minute crustacean cyclops were observed, resting against its glass sides or darting swiftly through the water, the females bearing on each side of them the ovoid sac of eggs which forms so conspicuous a feature of their appearance."

Prof. Peck, the State Botanist, who examined the aquatic plants from Caledonia, said: "There is among the mosses one of special interest, both because of its rare occurrence and because of the noticeable coincidence between its abundant growth there and the abundance of animal life that accompanies it. * * * It is known to botanists by the name *Hypnum noteraphilum*, or moisture-loving moss. Franklin and Lancaster counties, Pennsylvania, are its previously reported localities, where it is said to grow in limestone springs. It was discovered in the Caledonia Creek several years ago * * * but up to the present time this remains its only known locality in our State." Prof. Peck advises that in transplanting this moss, limestone waters should be selected, although one of the mosses associated with it at Caledonia occurs in waters free from lime. Prof. Lintner says that the small crustaceæ of the family *Gammaridæ* undergo no metamorphoses after their escape from the egg, and therefore give promise of no difficulty in their propagation, and he thinks that in time every order for 5,000 brook trout will be accompanied with an order for 100,000 shrimps. The food of the shrimps is in doubt, "but they are believed to be principally vegetable feed-

ers, although eating animal matter in a decayed state when convenient to them." Again quoting from Prof. Lintner: "The ordinary laws of nature give us a prodigality of insect life almost infinitely in excess of fish fecundity. A fish deposits her spawn but once during the year, but in the aphis or plant louse in one year there may be twenty generations. Latreille says that a female aphis produces about twenty-five young each day, and Reaumur proved by experiment that a single aphis might be the progenitor of nearly six billion descendants during her life. The crustaceans are also remarkably prolific. * * * the proposition to propagate crustaceans and insects for fishculture must be regarded as intimately connected with that of transplantation—perhaps as a corollary of it."

Mr. Thomas Andrews of Guildford, England, a noted pisciculturist whose reputation as a successful fish propagator is broader than his native land, in writing me of some large fish in one of his ponds, said that they were grown in ponds containing an extraordinary amount of natural food, which he made a point of cultivating. I asked him to tell me what this food consisted of and his manner of rearing it, and he writes as follows:

"WESTGATE HOUSE, GUILDFORD, Eng.,
May 7, 1892.

"I make a great point of natural food for my trout, and devote several boxes of 10 or 12ft. long, 6ft. wide and 1ft. deep to that purpose, besides numerous small ponds and side streams. In order to appreciate the value of the principal, and I consider the best, food for young trout, viz., *Gammarus pulex*, one must observe them at this season of the year, and they will be found in pairs. If a pair is captured; the male insect detaches itself from the female, and she will look large on the abdomen and of an orange color. If she is placed in the palm of the hand and slightly pressed with a camel's hair pencil, the young will be squeezed from her. This is my food for young

fry! The young shrimp is just the size for a hungry trout seven weeks old, and I have often brought the *Gammarus* up from my ponds to the hatchery and fed them there. There are, of course, other insects which are very suitable for the young fish, and I cultivate largely the 'alder fly,' whose eggs are to be found on the rushes and grass hanging over the streams or ponds in May and June in England. I collect these eggs and hatch them out, turning the larvæ into the water. I need hardly tell you that they are almost microscopic, and just the thing for the young fish. Then there is the 'grannom fly,' which I cultivate by bringing home the eggs which are found in bunches, attached to rushes, bits of stick, grass and woodwork in the rivers. To-day I had a can of grannom eggs sent up, and I should think there is a bushel basketful of these. They will be sent down to my ponds on Monday and placed just as they are in among weeds and rushes and will hatch in due time. The May-fly we can and do introduce in the same way, but until last season they were put into a pond where there were about 15,000 yearlings, and they stood but little chance to increase. Last season the eggs of the May-fly had a place devoted to them, where there were no fish, and we have found quantities of larvæ already. We also cultivate the *Limniadæ* (snails), and the young of these make capital food for my fish of all ages. We feed the snails and shrimps on liver and horseflesh, and where my man washes his meat sieve the snails have collected in heaps and devour all that is washed off the sieves My experience has taught me that one yearling fish is worth a hundred or a thousand fry for stocking purposes, yet I do not deny that a great many fish can be saved in the fry stage by artificial feeding. I get fewer fish, perhaps (by feeding natural food), but I get monsters of 6, 7, 8 and 9in. in a year, and my yearlings fetch three times the price of some other pisciculturists. Public opinion also in England is in favor of yearling or two-year old

fish for stocking purposes, and the results are more satisfactory by far. We cannot get anything like enough yearlings or two-year olds to supply the demand, and most people over here have given up stocking with fry. There is of course a sale for fry in England, as proper rearing ponds have in many cases been made, but the general opinion is in favor of yearlings."

Mr. Andrews's letter shows the way to vast possibilities, not only in the line of rearing trout fry in ponds on natural food, but in supplying mature fish in wild waters with a generous addition to their larder by transplanting eggs, larvæ or imagos of various insects. It is a most fascinating subject, but the pages already written warn me that I must be brief. The alder-fly and grannom-fly, referred to by Mr. Andrews, belong to the dun tribe, the former being the alder, orl or light dun, and the latter the green-tail or shell-fly of the fly-fisherman. The duns belong to the family *Phryganidæ* and are called caddis-flies, and the larvæ are called caddis-worms, and are sometimes confused with the May-fly, which they should not be. The dun or caddis-flies are so common, that a description of any one of the score or more species is unnecessary. The larvæ or creeper cases are hollow cylinders, smooth inside, composed of straw, grass roots, small stones and shells, and closed at one end. They are excellent trout food; every trout fisherman is familiar with them, and they are easily collected for transplanting. D. Barfuth, of the University of Bonn (Report U. S. Fish Commission 1873 and '74 and 1874 and '75, p. 735), examined a number of the common trout of Europe (*fario*) and found these to contain the creeper cases of *Phryganidæ* as follows: In one, 136 cases; in another, 585; in another, 116; in another, 186, and in another, 115. Of six trout examined, the cases were found in all the stomachs, and also in the entrails; in one, the intestinal canal, as far as the anus, was completely stuffed with the cases.

A book written by a lady for fly-fishermen, with the title, "Favorite Flies," soon to be issued from the press of Houghton, Mifflin & Co., Boston, will contain six plates of natural insects, including the different stages, of the May, caddis, stone and other flies.

Last year I experimented with the May-fly, *Ephemera*, to discover if it could be transplanted to waters where it was unknown, and found that it would bear safely a journey of twenty-four hours, at least. This fly is called the dog-fly, and one of the species—there are more than two dozen—is called shad-fly, and they are the "drakes" of the fly-fishermen, the "green drake" being the largest and best known Of the abundance of the May-fly it is said (Westwood's Introduction to the Classification of Insects), that in some pools of Europe it is customary to collect their dead bodies and use them for manure. The distinguished naturalist Reaumur gives this account (Introduction to Entomology: Kirby and Spruce): "The myriads of *Ephemeræ* which filled the air over the current of the river, and over the bank on which I stood, are neither to be expressed nor conceived. When the snow falls with the largest flakes, and with the least interval between them, the air is not so full of them as that which surrounded us with *Ephemeræ*. Scarcely had I remained in one place a few minutes when the step on which I stood was quite concealed with a layer of them from two to four inches in depth." This was near the River Marne, in France.

I know personally of but few places where the flight of May-fly is in clouds, but in one place in New York it closely approaches, if it did not equal, that related by Reaumur. In a flight of May-fly there will be discovered green, gray and purplish-black drakes. At first all are green, the female changing to gray and the male to purplish-black. Before my experiments with the May-fly on drakes, had extended beyond confining them to see how long they would live, the *Fishing Gazette*, London,

printed an article written by Major W. G. Turle, in which he described a completely successful experiment in transplanting and establishing the May-fly in waters where it was previously unknown. I gathered my flies in a bait bucket and a tin biscuit box, but Major Turle improved upon that by using band-boxes with lines of worsted from side to side for perches. The flies were caught by picking them from the bushes and placing them in the boxes, and the boxes were taken by railroad train to the waters which it was desired to stock, and there the flies were released on the bank. Major Turle was of the opinion that it required two years for the eggs to mature, but, as will be seen from Mr. Andrew's letter, it requires but a year. The illustration of the larvæ or creeper of the May-fly used in this paper was prepared for Mr. Frederic M. Halford's work, "Floating Flies and How to Dress Them," but was rejected for another process, and was very kindly loaned by Mr. R. B. Marston, editor of the *Fishing Gazette*, London, and a corresponding member of this society.

The illustration is 5in. long, and a particularly fine cut, but the natural creeper is less than 1in. in length. The larvæ as well as the fly can be transplanted, and besides furnishing food for the fish the diet may teach and encourage the trout to rise to a fly.

The Chairman invited remarks and discussion on the two papers now before the society:

Dr. James—The subject of "Food for Fishes" is much too important to be passed without discussion. I was very much interested in the paper, because it leads to the all-important subject of giving us good fish. If our fish are lean and have not a good flavor, we certainly lose all enjoyment for that kind of food; and the more we can improve the variety as well as the fatness or quality of the fish, the better it is in the market. Of

course the more valuable any of these fishes become to us as articles of commerce, the greater the desire of those who fish to obtain these better varieties.

It seems to me that this is a subject that ought to be taken into consideration not only by the different States and by those who are in the habit of making fish culture part of their business or their pleasure we may say, but that it ought to be in some way encouraged by the government. There are out in the Rocky Mountains, many of the streams off in the mountain districts that are not yet well known and uninhabited, that ought to be stocked with fish. In stocking these fish, this subject of preparing food for them, or the kind of food on which they can survive, ought to go hand in hand. There are thousands and thousands of persons who are dependent on the internal fish supply away off in the interior of our country, which supply can only be kept up by stocking the streams and lakes which have their sources in the Rocky Mountains and the other mountains north and south. And the government really should, it seems to me, take this whole matter into consideration, and while it is transplanting the eggs of different kinds of fish that will survive in those waters, they should make a general law which would not only stock them, but supply the proper kind of food. Out in those waters in the Rocky Mountains, where there is nothing else but rocks in some places, there must be some sort of material supplied such has been suggested by this paper. Those of you who have been there will have noticed the contrast between the rich, luxuriant growth we have here in the East, where there is a great amount of moisture, where there is a great supply of those kinds of flies, insects and other animals, which are not to be found out there. Some varieties of this food probably could not be transplanted, but certainly there are some which would grow there and flourish. But of course there is no use placing them there until the fish have been grown and transplanted.

MR. MATHER—This subject of food is the one important subject. It has been stated several times that in Europe there is somebody who has a system by which he breeds insect life and small crustaceans, and drives his little fry from one post or point to the other. I have investigated to some extent, and I never could find anybody that could show that it was a practical thing to be done. Of course wild trout feed largely upon insects, but I have never seen any way clear to breeding insects in quantities sufficient to feed any number of trout. If a man has a pond with only four or five thousand trout in, it is possible there may be insect life enough to support them. But I did try years ago—it must have been twenty years ago, I think—to breed mosquito larvæ for trout; it was very good food for the little fellows; the only trouble was to get enough of it. Taking rainwater barrels, and straining them and getting the larvæ out; and the little trout feed well on it. The trouble was to get it in quantities—to get pounds of it. Another trouble is that the mosquito larvæ does not come quite early enough for those that are in the earliest stages and begin to want food.

But the May-fly and its larvæ are excellent food for trout. I have seen them on the Hudson River when I have been hatching shad; at nights they would sometimes darken our lanterns, and wash up along the shore the dead bodies in such quantities so that you might smell them. Along the Hudson and Connecticut Rivers they are known as the Eel-fly. But how to propagate those things, to get enough so you could estimate it by pounds, I really don't see the way, but I should like to very much.

MR. GILBERT—It has been my experience in regard to freshwater shrimp, we always find them in every good trout stream—in Massachusetts especially. Trout must have a temperature of water not above sixty-five degrees at any time, but rather a temperature of not far from fifty degrees. They will germinate, thrive, breed

and increase in water of that temperature and none other. In my brook, you take up a watercress, or any kind of aquatic plant, and it is literally alive with freshwater shrimp. We do nothing to breed them or increase them. Trout are feeding on them all the time; I presume there are hundreds of thousands. In one place I have got 20,000 yearlings that are from four to seven inches long. There are more or less aquatic plants in the brook; take one of them up and it is actually alive with the freshwater shrimp. They must increase very fast, for these yearlings are constantly feeding on them.

Now in regard to the feed of young fry: We begin to feed along about the first of April, and at that time of year there is any amount of (heidic) spawn, in March and April, and that has been in my experience the best feed that I could get as food for the young fry. I can buy any quantity in Boston; I presume you can in New York. I have got it up to about the 20th of May. Up to that time we feed on (heidic) spawn exclusively. After that, by the time that is gone, they are an inch and a half long, some of them two inches in length, then we begin to feed them on liver, pulverized very fine.

THE PRESENT STATUS OF TROUT CULTURE.

By Wm. P. Seal.

Trout culture may truthfully be said to have been, since its inception, the great fishcultural school.

Whatever doubts may have existed in the past regarding the fundamental and underlying principles of fishculture, they no longer have a place in the minds of those who are cognizant of the present aspects and results of the development of the science. Fishculture is no longer on the defensive, but stands to-day showing economic results not achieved by any other branch of public work. Whatever attacks are yet made upon it are levelled at trout culture generally. It sometimes happens that other branches of fishculture are assailed because of the effects of local changes in catch and distribution of fish induced by changes in fishing methods, as with the shad; and because these are not understood by the general public who do not see beyond their local fishing interests.

It is one of the misfortunes of our political system that for partizan advantage we often find a great deal of fault with everything originating with our political opponents, and that we are not satisfied to applaud unless the beneficial results of a public policy can be properly credited to our own particular party. We often differ on important public questions for no better reason, and with our legislators this often stands for statesmanship. It is probable, however, that there is in general less of partizanship in the support of fishcultural measures, and more of a common bond of fellowship among those interested in fishprotection and fishculture, than may be found in almost any other field of contemporary human interest. This is as it should be, and the bond should be strengthened, and the unholy leaven of partizanship cast out as unworthy of a place in the minds of men working in a

common cause for the general good. Otherwise the enthusiasm of men is repressed, the halting and inefficient find their way into places for which they are unfitted, selfish motives prevail, progress is retarded, and the public mind becomes suspicious and uncertain. On this account the removal of men engaged in fishcultural work, for political reasons, should be unequivocally and unanimously condemned and rebuked by this society. It will only be by the vigorous, unselfish and consistent action of those engaged in the work, that the bulwarks of safety for all will finally be established.

It is unfortunately the case also that among fishculturists, as among men engaged in other pursuits, a true scientific spirit does not always prevail. They are too easily satisfied and sometimes get into ruts from which they are not willing to emerge. When a man starts out with a preconceived theory, and spends his life in seeking for arguments to sustain his position, instead of searching for the truth alone, he makes but little progress. Truth alone should be the goal, and whatever suggestion there might be from any source should be seized upon and examined with unprejudiced mind. "What is the truth in the matter?" might well be the scientific worker's creed. A little broadening of our views and the inculcation of an ardent scientific spirit might result in a much more rapid progress in fishcultural development, now that there is no longer uncertainty as to its economic value. The urgent insistance of fishculturists in favor of their particular methods, while decrying those of others without thorough experiment and observation, though it may show a confidence calculated to be assuring, is not so strong as an argument, as a more patient and painstaking investigation would be. Moreover, where conflict of opinion reaches such a pitch that each side denounces the work of the other as impracticable, or of doubtful utility, unless it is a very clear case, the public mind is apt to decide that

there is a strong possibility of correct judgment on both sides.

The wide divergence of opinion among trout culturists at the present time, as to the most effective methods of stocking, with the counter-argumeuts made, is not assuring to many well-wishers of this branch of fishculture. It seems to the writer that the time has not yet arrived when any phase of trout culture as yet developed in the United States, can be hailed as the ultimate limit of possibility, or that the experimental stage is passed.

It would be well, perhaps, before discussing the various aspects of trout culture, to recall the arguments in favor of and against this branch of fishculture as carried on at the public expense, inasmuch as the periodicals of the country devoted to the dissemination of whatever relates to fishculture are open to virulent attacks, by irresponsible cranks, upon those engaged in that pursuit, charging them with being robbers, engaged in looting the treasuries of the State and National Governments. It is the usual policy to allow such attacks to pass unnoticed, and, if there is doubt as to the value of trout culture, perhaps that is the wisest policy; but it has always seemed to the writer that the general public want, and have the right to know, the truth in the matter, and that if it can be shown by argument based on demonstrated experience, and not by unsupported allegations and invective, prompted by personal motives, that the work is of doubtful value, it should be abandoned for other branches of fishculture holding forth greater promise of usefulness. It is certainly quite easy to bring very plausible arguments to bear adversely on this question when not considered broadly, or if one side of it only be touched, and it is the belief of the writer that inasmuch as it is generally conceded that to attain the best results in trout culture, vastly greater outputs, requiring greatly increased appropriations, are required, or, that more effective methods of stocking must be developed, it is

just as well that all attacks should be met by amicable and reasonable argument, as constant and persistent as the unsupported statements of its opponents. Once convince the people of its economic value of any phase of fishculture, and they will see to it that the legislators support it. Any dependence on partizan advantage, the support of a particular class of the population, or resort to "star chamber" methods in fishculture, will eventually result in disaster to the cause.

The most potent arguments against trout culture at the public expense, and especially as applied to the general government, are:

First, That a few localities only are benefitted by attracting anglers thereto, and that the work should be carried on by the sections benefitted.

Second, That the areas available for the purpose are rapidly diminishing by reason of the denudation of the land, thus destroying the great natural storage reservoirs and producing an alternation of droughts and floods, causing the destruction of the natural food supply, and raising the temperature of the water, and that nothing permanent can be accomplished and therefore the results are not, and cannot be, commensurate with the outlay.

These arguments, of course, have no weight with the angler; but public fishculture can be permanently established and maintained only upon economic considerations, and nothing is to be gained by evasion. It is therefore proper in the best interests of fishculture to refer to them, and to see if there is not a valid answer to them.

The advantages of healthful recreation to thousands of our best and greatest citizens might be advanced, but it is not sufficiently strong as an argument in the premises. There is, however, no doubt of the fact that a much greater interest and sympathy is awakened in the interest of fishcululture generally through the more universally under-

stood methods of trout culture than by any other means. It has been in fact the nursery, the kindergarten, and college of fishculture. But for the persistence with which it was followed by a few enthusiasts, while many fell out by the way, fishculture to-day would be still looked upon as an impracticable dream.

To-day trout culture has become largely supplementary to much greater branches of fishculture, but as a training school in the handling of fish it is yet paving the way to still greater fishcultural triumphs. The knowledge that is being gained by experiments in hybridization, acclimatization (transfer and adaptation), the studies upon the variation and modifications of species under changed conditions, although not as systematic and well sustained as is desirable, are of great value as observations and training which will have an influence and bearing on other phases of fishculture as they may be developed in the future.

The economical handling of live fish, once so difficult, is rapidly being reduced to a science largely through the experiences of trout distribution, they being among the most difficult fish to transport. The keeping of trout in aquaria has been revolutionized by reason of experiment in this direction, the use of ice now not being considered necessary under a temperature of seventy-five degrees.

The treatment of diseases of fish and the destruction of fungus on them is making progress mainly through the handling of trout.

These, of course, may be considered as minor points only among the beneficial aspects of trout culture. The most important argument to be advanced is that it is believed by all who are familiar with the subject that from a financial standpoint the aggregate of trout used for food in the United States could pay many times the sums devoted to their propagation. There is no question but that for artificial propagation they would have long since been exterminated. As from the very nature of the methods

of catch and distribution of trout as food, they not forming commercial fisheries, there can be no collection of statistics bearing thereon; this is a favorite point of attack.

Whatever differences of opinion may exist regarding the economy or efficiency of the opposing methods employed in trout culture, the question remains as to whether the best possible results have been attained and whether there is no stimulus to further investigation and experiment.

The economic cultivation of trout is assuming such importance as to cause in the State of Massachusetts a lively agitation concerning the marketing of such as are reared by artificial means during the close season. One of the claims of the opponents of trout culture has been that it is impossible to cultivate trout for market economically. The value of this fact, therefore, should be appreciated as a great triumph of fishculture and should receive all encouragement. To be universally popular, fishculture must be based on economic or food considerations, and not on those of sport. Therefore it is to the interest of anglers to make such concessions in matters of this kind as to convince the general public that they are actuated by motives not wholly selfish. It is only by fair and politic treatment of such questions that the sympathies of the people will be aroused in the general interests of fishcultivation and protection, and through which the interest of the angler will be most effectually advanced. The opposite course will only keep alive the doubts and objections which prevent their advancement. It is only necessary to note the meagre appropriations of the State of New Hampshire, the efficiency of whose work is attracting universal attention among fishculturists, to show the lack of general appreciation. Neither fishculturists nor anglers can afford to take ground that will retard the business of rearing trout for market. And the people themselves will decide the question of quality.

The ancient Romans had their pampered eels, and may not we have our pampered trout if we like? Are not frozen fish better than no fish? As well need we distress ourselves that everyone cannot have fish right out of the sea! Certainly, also, if the cultivated trout is so easily distinguishable from the wild, as is generally alleged, there should be no difficulty of providing adequate safeguards against the violation of the laws protecting wild trout.

It should be remembered, at all events, that whatever will demonstrate the economic value of fishculture is the strongest possible argument, and the most potent influence, in its promotion.

One of the anomalies of the trout culture of to-day is the division of sentiment regarding the planting of yearlings and fry. It is claimed on the one hand that the planting of yearlings is much the more efficient method and instances are brought forward where repeated plantings of fry have failed to produce an effect on streams, whereas they have finally been successfully stocked with small plantings of yearlings.

The arguments in favor of planting yearlings are that being grown to a length of three to five inches they are better able to escape their enemies and to protect themselves against the Cottoids (millers'-thumbs and darters) infesting all rapid-running streams, where they harbor under the stones. There are also crayfish and large insect larvæ, such as the "helgramite" or "dobson" (larvæ of Corydalis Cornutus), which will destroy the fry as they take shelter under the stones.

Turn over the stones in a trout-brook, and small fish (*Cottoids*) will be seen to dart to shelter under other stones. These exist in great numbers in all such streams but escape observation except of the collector. They will destroy fry as soon as deposited. Not so the yearlings which are able to turn the tables on them and to devour at least the smaller of them. Many experiences

in Europe and the United States are given in support of this belief.

There is another argument which has been advanced in the fact that in depositing yearlings they can be actually counted and there can be no ground for suspicion concerning the statistics of output.

On the other hand it is argued by some that the cost of rearing yearlings will not warrant it. It is also argued that when fish are brought to the yearling stage in captivity their natures will have become changed, the natural instinct of self-preservation will be lost, and thus they will become an easy prey to their enemies.

It is also said that if fry are properly planted—that is, in the head waters or feeders to trout-brooks (spring streams)—there is but a small percentage of loss among them.

While the writer is only presenting these opinions as a preliminary to the unfolding of the object he has in view in the preparation of this paper, he cannot refrain from saying that all his experience in the examination of small cold streams has shown them to be swarming with crayfish, cottoids and salamanders, clear to the fountain heads, the springs. That these are not noticeable to the casual observer and that their presence will not be known except by removing the stones. The "helgramite" is not always present, but the others are rarely, if ever, absent.

Now in the best interest of trout culture, is not this a question worthy of closer examination and more extended experiment? Is it well to consider the matter settled one way in one State and in a different way in another State? Ought not the question be the subject of continued experiment in the States interested in trout culture, without bias and with a desire to develop the truth only? Do not the best interests of trout culture require a sympathetic and progressive treatment of the subject?

If, however, on the other hand, trout culture is established on so firm a basis that those engaged in it may safely indulge in dissensions and that we may consider that the ultimate of possibilities has been developed, the writer has only to apologize to the trout culturists of the country for his temerity in approaching the subject.

This brings the writer to the point which he desires especially to present for consideration. At the last meeting of the American Fisheries Society, there occurred some desultory discussion concerning the cost of rearing yearling trout, during which reference was made to certain methods of producing natural food for the purpose, now used in Europe. It was developed that but scant consideration had been given to the methods in question and that but little was known about them. Those who are sufficiently interested in the subject will find much of value in three papers, herewith appended, from the Bulletin of the U. S. Fish Commission for 1887 (Vol. VII., pages 203 to 215), viz., "Self-Producing Food for Young Fish," by Frank H. Mason, Consul; "The Piscicultural Establishment at Gremaz (Ain), France," by C. Raveret-Wattel, and "Report on the Piscicultural Establishment at Piedra, Aragon, Spain," by F. Muntadas.

Perhaps the only fishculturist in this country who has given attention to the production of natural food for young trout, or at least who has recorded the same, is Mr. Charles G. Atkins of Maine, but his experiments appear to have been confined to the larvæ of flies (otherwise maggots), but in a somewhat improved manner. The following items bearing on this question of natural food are taken from the report of the U. S. F. C. of 1882, p. 1,011, viz.:

"Thus the *Deutsche Fischerei Zeitung*, 1880, p. 25, maintains that by feeding trout on worms their weight can be increased in one year from three-fourths of a pound to two and a half pounds;" and "As regards feed-

ing fish on snails, Dr. Molin says in his 'Rationellen Zucht der Suswasser Fische,' p. 13, that Commander Desme had a pond containing 150 hectolitres on his farm at Puy Girard, in which he fed young salmon and trout on pounded snails, and by this method of feeding he increased their weight on an average by one pound per fish."

That forms of life inhabiting the water and being equally or more prolific than the flies or worms would be far preferable, needs no demonstration.

However we may differ as to some features of the methods recounted in the papers in question, the fundamental principles are essentially the same and deserve careful consideration, as numberless adaptations of them may be evolved.

A paper by Mr. A. N. Cheney, entitled "Stocking Trout-Waters With the May-Fly," which appeared in *Shooting and Fishing* of March 31st, 1892, has still another and a very practical bearing on the subject in general.

The propagation of natural food has been followed for a number of years by the writer in the cultivation of ornamental fishes with complete success, the possibilities in the production of crustaceans being limited only by the space devoted to it. Further than that, if space was lacking for the purpose no difficulty was ever experienced in getting abundant supplies from nature. It is only a question of knowing how to go about it. Stagnant waters everywhere, and especially those destitute of fishes, abound with certain kinds of them, but principally with Daphnia and Cyclops. Watercress beds and masses of other aquatic plants are alive with other kinds of them, such as Asellus Vulgaris (Water-hog, water-asel) and Gammarus pulex (freshwater shrimp). Masses of dead leaves in the waters of springs or spring streams harbor them in great numbers. But the conditions in nature that promote their development are not nearly so

favorable as they can be made by combining the natural and artificial. There is no necessity for the introduction of any foreign material to stimulate a production of the crustaceans, as the natural conditions afford all the requirements for sustenance, but infusions of dung or vegetable matter will attract ephemera and other flies to deposit their eggs. Nor is there any necessity for driving fish from one pond to another, as the food can easily be caught and transferred to the fish basins.

Let any trout culturist make a small cheese-cloth net, and using it among water cresses or other aquatic plants in shallow water, note the immense numbers of larvæ and crustaceans that may be taken.

Or, make the experiment of spreading the water flowing from a spring so as to make it shallow. Plant it thickly with water cress and nature will speedily stock it with animal life. Again, take a small pond or trench without fish and put into it a few Daphnia and Cyclops, and note the result.

The experiences of the writer confirm those of the European fishculturists who have applied these methods to trout culture, and he has no hesitation in recommending them to American trout culturists as worthy of general development. They are applicable as well to the rearing of any kind of fish, carnivorous or vegetarian (so called).

The writer took the ground at the last meeting of the society that the time would come when greater areas would be devoted to the rearing of natural food for young fish than to the holding of the fish themselves, and that enough food to rear a yearling trout can be produced within the limits of a cubic foot of water.

The advantages of an artificial system over purely natural conditions in the production of these creatures is the same as in the propagation of fish. Where exposed to the ravages of the fish themselves the multiplication will be slow, if not wholly arrested, because the breeders

will be destroyed as well. In separate basins, however, there is no restriction on the production and the fecundity is so great the accumulation is enormous. Thus while one basin is being depopulated others can be repopulated.

For young fry the smaller crustaceans (Daphnia and Cyclops) are required. When probably one and a half or two inches long they will be able to take the larger ones. Young trout in aquaria will always take these in preference to dead food, as it is natural they should.

This work may be carried even further by making wood or cement lined trenches, covered with sashlike hot beds, through which the waters of springs may flow, for both the fish and food; the inlets and outlets to be protected by wire gauze. Such methods involve more expense in the beginning but might prove less expensive in the end.

It must be confessed that the writer's only practical experience in this direction (except in the handling of trout in aquaria) has been with ornamental fish, the gold fish in particular. With these he can say from actual experience that as many can be reared in a cemented basin covering 200 square feet and costing not over fifteen dollars (necessarily), than is usually produced in a natural pond of half an acre, and further, that the same results can be produced season after season without variation, which is not the case in nature.

And the reason is that in the pond the earlier hatchings will eat the later ones, while in the artificial basins they can be apportioned according to size. The old ones will eat the young. The young ones become the prey to innumerable forms of pond life from the voracious hydra to the multitude of water insects and larvæ, crayfish, frogs, snakes, herrons, kingfishers, etc. These elements of destruction, everywhere present in nature, can be wholly eliminated by the adoption of a proper system, while at the same time all the advantages of natural conditions may be afforded.

In the cultivation of gold fish it is possible to retard the growth by the feeding. This would not be desirable in general fishculture and is only referred to as an evidence of the advantages to be gained by an established system over absolutely natural methods.

Whatever reception awaits it, the presentation of this paper can at all events do no harm. It simply reflects the opinions of the writer looking at the question from a standpoint somewhat apart from that of the trout culturist or the angler, but possibly, however, with a more ardent belief in a progressive future for trout culture than is evidenced by either. A full discussion of such questions is certainly calculated to advance the development of the latent possibilities of fishculture. This belief, at least, is the writer's justification for trenching upon a field where he is not a practical worker, but an interested observer only.

(Bulletin of the U. S. Fish Commission, 1887, p. 207.)

THE PISCICULTURAL ESTABLISHMENT AT GREMAZ (AIN), FRANCE.

By C. Raveret-Wattell.

About four years ago I had the honor to call the attention of the National Acclimatization Society to a pisciculturaI establishment which had been founded in the Department of Ain, at Gremaz, in the township of Thoiry, for raising trout as an industry. I pointed out the special interest which, in my opinion, this establishment seemed to possess, as its founders, Messrs. Lugrin and du Roveray, have succeeded in solving a problem of considerable importance from an industrial point of view, viz., to furnish the young fish with food solely composed of living prey proportioned to its size.

It was exceedingly important to find some natural food

for the young fish, and since Messrs. Lugrin and du Roveray have demonstrated the great usefulness of the Daphnia in this respect, several pisciculturists have looked for some practical means of providing a sufficient quantity of these small crustaceans. Attempts to multiply them rapidly in ditches filled with slightly muddy water succeeded; but this method presents serious inconveniences. According to Mr. Chabot-Karlen, the Daphnia gathered in these ditches are extremely tender; the least agitation kills vast quantities; the greatest precautions are therefore required to gather them; and, moreover, these small crustaceans impregnated with muddy water must be carefully washed in clear water, in order not to become actual poision for the young fish.

The method employed in the Gremaz establishment is by far preferable. As I have stated in my previous report ("Bulletin de la Societe d'Acclimatation," November, 1882), the Daphnia are raised in the very basins which are destined for the fish. When a basin has been sufficiently prepared for the development of these small crustaceans, they are allowed about a month's time to increase; then the fish are put in the basin, where they at once find abundant and substantial food. Whilst this stock of food is being consumed, other provision is made. A neighboring basin is prepared like the first; *i.e.*, it is abundantly stocked with Daphnia. After another month has passed, the fish—which by that time have consumed nearly all the food in the first basin—are put in the second, where they again find ample food. A month later they are again put in the first basin, which meanwhile has again become stocked with Daphnia, and so on. This method is extremely simple and convenient. Messrs. Lugrin and du Roveray, however, do not confine their efforts to raising Daphnia, but they likewise use larvæ of insects, and especially small freshwater shrimps, which, as we shall see, form an exceedingly abundant article of food, particularly in winter.

When, in the year 1882, I visited the Gremaz establishment for the first time, I was positively astounded at the quantity of Daphnia in the basin, forming dense clouds in the water. But that was the beginning of October, after a long period of fine and warm weather, during which these small crustaceans had had a chance to multiply at an enormous rate. I was, therefore, curious to return to the establishment to see how matters stood during the bad season. From this point of view no better moment could have been selected for my visit. Without being exceptionally severe, the winter in this region has been somewhat prolonged. Shortly before my arrival the thermometor had fallen to 13 degrees below zero. On the day of my visit it was still 3 degrees below zero, and the basins, which had a feeble current of water, were covered with ice. The ice had been broken in several places, and we could, consequently, examine the water underneath. I must say that the Daphnia appeared to me to be just as numerous as during the fine season, which. however, is easily explained in water as cold as that in these basins; but when we dipped out some of the water from the bottom of the basins, with a sort of canvas purse-net, we brought up incredible quantities of larvæ of the Chironoma and still more larvæ of the Ephemera. The whole bottom of the basins seemed to be one mass of animal life. At every haul we got a big dish full of these larvæ. which are an exceedingly valuable article of food for the young fish. The water which is artificially prepared for the Daphnia is, therefore, likewise well suited for the developement of other small aquatic animals which can be utilized as food for young fish.

But Messrs. Lugrin and du Roveray are not contented with this source of food. Alongside of the basin there are small rivulets artificially made for raising small freshwater shrimps (Gammarus pulex) which, by a method similar to the one employed for the Daphnia, are caused

to multiply in enormous numbers. In these rivulets, filled with water cresses and other aquatic plants, the little shrimps, which form so important a part of the food of the trout, are raised. Every day the daily rations allowed to the fish is gathered with nets in a few minutes; and it is a curious spectacle to see this food given to the fish. The young trout come from all directions in dense masses. They vigorously attack the little shrimps and do not allow a single one to get to the bottom of the water. No matter how large the quantity of shrimps it vanishes in a few moments.

The young fish of Messrs. Lugrin and du Roveray thrive admirably on this diet. Three basins, each having a surface of about 120 meters, contained about 70,000 fish of this year's raising, grouped according to size, and all in excellent condition. From their well developed stomach and their finely rounded forms, it will be seen that these fish have not only never suffered hunger, but that they have always had abundant food of excellent quality. This kind of food, composed exclusively of insects and small crustaceans, is exceedingly suitable for these young fish on account of the large quantity of phosphate of lime which it contains; (1) and this circumstance explains the rapid growth, and the exçeptionally fine and vigorous condition of the young trout raised at Gremaz.

It may be well to add that the profitable use made of the small shrimp streams will soon give way to a still simpler method of utilizing these small crustaceans, by proceeding in exactly the same manner with Daphnia, *i.e.*, the fish will be successively, or rather alternately, passed from one basin to the other, to consume a stock

(1.) It is well known that the substance which forms the skeleton of insects and crustaceans is, with many species, largely composed of calcareous matter, and is exceedingly rich in phosphate of lime. It is probable that to this circumstance must be attributed the result of Stoddard's experiments: "Three lots of young trout were placed under absolutely identical conditions; one lot was fed on fish, the second on Annelida and mollusks, and the third exclusively on insects. All the fish of the last-mentioned lot developed much quicker than those of the others." In England insects are also considered excellent food for young trout.

of food previously prepared for them. By experiments Mr. Lugrin has ascertained that a basin 35 meters (114.8 feet) long, and 3 meters (9.84 feet) broad, with an average depth of water of 40 centimeters (1.3 feet); (2) may contain 20,000 young fish from eight to twelve months old, or 3,000 two-year old trout, having an average weight of 250 grams ($\frac{11}{12}$ or a little more than $\frac{1}{2}$ pound). These 20,000 young fish or 3,000 trout, consume about 10 kilograms (about 22 pounds) of small shrimps per day; (3) or 300 kilograms (about 660 pounds) per month. It has been proved by experiment that a basin having the above-mentioned dimensions can produce 300 to 350 kilograms (660 to 770 pounds) of shrimps, without at all interfering with the Daphnia, Nais, Limnea, insect larvæ etc., which simultaneously develop in the same basin. Under these conditions food will never be lacking. It is sufficient to have two basins for each lot of fish, so as to transfer then each month from one basin to the other.

The system employed at Gremaz is, therefore, exceedingly profitable from an industrial point of view. But it is specially destined to render excellent service in stocking rivers with fish. Doing away with all the difficulty as regards food, it makes it possible and even economical to keep young fish, intended for stocking rivers, for a certain time in the basin free from all danger. Those young fish, which, owing to the lack of suitable and sufficiently cheap food, had to be set out in the rivers at a very early age, before they had had time to gain strength, may now be safely left in the basins till they have grown stronger. When several months old the young fish is already vigorous; it knows how to flee from danger; it is, therefore, better able than younger fish to escape numerous accidents and causes of destruction. Rivers, there-

(2.) These are the dimensions adopted for the new basins of the Gremaz establishment, the projected enlargement of which contemplates the creation of 136 such basins.

(3.) Ten kilograms (22 pounds), dry measure, of small shrimps represents about 7 litres (about 1¼ pints of liquid measure.

fore, may be stocked with much greater prospect of success; and it may safely be asserted that 3,000 or 4,000 young fish, ten to twelve months old, are infinitely more valuable for stocking a river than 10,000 or 15,000 very young fish, which, not being strong enough to bear the change from the basin to the river, often perish in large numbers when placed in the river, where they become an easy prey to older fish living in the same waters.

This opinion is at this day shared by the vast majority of pisciculturists in Great Britian. Nearly everywhere in England and Scotland it is considered that the best young trout for stocking rivers are those which are about a year old, and which for this reason are called "yearlings" (4).

These young fish are strong enough to seek their food and consequently to avoid the principal cause of mortality in young fish, viz., inanition; they can easily be transported and will bear a change of water without difficulty. These young fish cost, it is true, considerably more than others, but as the final expense is much less, and the result is more prompt and certain, there is an absolute advantage in using them for stocking rivers.

There is only one point in the system which leaves something to be desired. If one operates on that large scale which is required for stocking an entire river, it envolves considerable labor to insure the feeding of the young fish with artificial food. As the animal is, so to speak, made during its early age, and as during this period its assimilating organs acquire their strength and their power of absorption, a young fish which is insufficiently fed not only grows very slowly, but will never become a fine fish. It has been ascertained long since that if, of young fish of one and the same hatching, one

(4.) This term is really applied to fish which are in many cases from ten to fourteen months old. Practically speaking, the age of a fish is counted from the date when it begins to eat, and not from the date when it was born. Thus, a trout of 1887 is a fish which commenced eating in February or March, 1887, although it may possibly have been born about the end of the year 1886, and not in the beginning of 1887.

portion is immediately placed in the river, whilst the other portion is kept in basins and fed with extreme care, the first will, after a short while, be twice as large as the second, because they have food which is better adapted to their needs; only, the loses among those which have been kept in basins will not be as large (unless the circumstances are particularly unfavorable), whilst the ranks of those which have been placed in the river have often been thinned to such an extent as to leave hardly any. They have fallen a prey to water rats, perch, pike, and even older trout.

Thanks to the system of raising employed by Messrs. Lugrin and du Roveray. all these inconveniences disappear; kept in basins, protected against all danger, the young fish, abundantly fed on live food, develop as well if not better than under natural conditions without involving any serious expense for their food; and when the suitable moment has arrived, they can easily be transferred to the waters for which they are intended, without running the risk of losing many.

It is therefore greatly to be desired that the Administration should abandon the use of very young fish for stocking rivers (as they are nearly all doomed soon after they have been placed in the river), and give the preference to fish ten or twelve months old, which, as is stated above, have yielded the most satisfactory results in England and Scotland.

Messrs. Lugrin and du Roveray, convinced of the advantages of their system, propose, at their own expense, to stock a water course which, being subjected to special supervision, will enable them to make an absolutely convincing experiment.

(Bulletin of the U. S. Fish Commission, 1887, p. 211.)

REPORT ON THE PISCICULTURAL ESTABLISHMENT OF PIEDRA, ARAGON, SPAIN.

By F. Muntadas.

All persons who devote themselves to practical pisciculture will remember the change of opinion which took place some years ago, owing to the weakness of many persons whose experiments proved failures. Our Acclimatization Society, however, has never allowed itself to be influenced by the "piscicultural malaria;" it has always stood firm and preserved its faith in the future; it well understood that the discovery of two fishermen of the Vosges Mountains could not become merely a subject of curiosity or pleasure. It is true that a large number of amateurs have taken a wrong road, but many others have followed the right road, and have made marked progress in the successful method of raising salmon.

From the moment that the question of raising large quantities of young fry and young trout was agitated, it became necessary to pay attention to many different circumstances, and not to forget the cost of raising fish; for the problem is to derive some profit from the new industry, and, according to Mr. Larbaletrier's expression, "to make money by pisciculture, and not pisciculture by money."

All the methods of artificial feeding are expensive, and, what is worse, do not entirely answer the purpose; it therefore became necessary to find and use natural elements. In short, it became necessary to give the young trout what it needed.

I had read in the "Treatise on Pisciculture," by our late co-laborer, Mr. Carbonnier, that in places where the freshwater shrimp (Gammarus pulex) is produced, the

raising of salmonoids was easy. I ransacked my waters for these precious crustaceans, and, having found them in considerable quantities in the sources and along the course of the Devil Rock Brook (Pena del Diablo), I went to work and had my first rearing-basin constructed. It was a complete success, and I had the honor to report it to the Acclimatization Society, which rewarded me by one of its medals. My young fish swallowed the little shrimps with the greatest delight, and seemed to care very little for the coagulated blood which was given to them in accordance with the instructions of the majority of treatises on pisciculture.

Ever since my first season I have used nothing but small shrimps for feeding my young trout, which grew amazingly fast. This method was followed during the first eight months. Later they found in the large basins (besides myriads of small shrimps) tadpoles, gudgeons, and craw-fish, of which they are very fond, especially during the shedding period of these crustaceans. In a special compartment I tried chopped meat (mutton, rabbit, etc.), but when I found that the carnivorous trout did not develop any quicker than the ichthyophagous ones, I fed them all on fish and crustaceans.

The enemies of the young fish (water snakes, water ousels, water rats, etc.,) committed great ravages in my open-air basins; and with a view to prevent these ravages, I had a basin constructed of cut stones 10 meters (32.8 feet) long, 1 meter (3.28 feet) broad, and 50 centimeters (1.64 feet) deep. The whole was covered by a small house with windows protected by gratings and a very close network of wire both down and up the stream.

The experiment had a two-fold interest, viz.: On the one hand to keep away the enemies of the young fish, and on the other to prove the success of my method of feeding the young fish after the umbilical sac had been absorbed. This twofold object was attained, and I am able to state

that not only was the loss smaller, but the young fish kept in this basin developed more rapidly than the others. When, in September, I transferred the young trout to more extensive waters, those which had come from the stone basin gained on the others in every respect.

In places where there is clear and cool water containing some lime, and where the freshwater shrimp reproduces naturally, I have discovered the best method of raising salmonoids. It therefore gave me great pleasure to read that at the Gremaz establishment Messrs. Lugrin and du Roveray had succeeded in solving the problem of raising young fish by the same means which I had employed here, and which I had described in the report which I had the honor to submit to the Acclimatization Society in July, 1872.

The closer we follow nature, the more certain we are of success. It may give an artificial pleasure to see a few young fish in a hatching-basin and to watch the absorption of the umbilical bag; some of them may even be kept for some time on more or less expensive artificial food; but when it comes to pisciculture on a large scale, when the object in view is to stock large sheets of water, these means are insufficient.

I well remember a long conversation I had with Carbonnier. He told me in a firm and convincing manner that, as I had on my property at Piedra a watercourse, which was always cool and limpid, and which had a considerable fall, I should abandon the Coste and all similar apparatus, and use the Jacobi box, placing it to half its height in the water (natural method), and, as I had large quantities of small shrimps, to give my fish small shrimps (natural food), and not think of any other food. I followed his advice, and my season of 1871-'72 was so remarkable that the Acclimatization Society rewarded me with the large gold medal at the public session of April, 1873.

From 1872 to 1874 I lived in France—two years lost to my pisciculture. On my return I had to begin over again; but as I felt sure of my method, I again set to work, and my establishment soon reached the high state of perfection which it had occupied prior to my visit to France.

The stone basin (mentioned already in my report for July, 1872) proved a great success. It produces on an average of 1,200 trout every year, and the open-air basins contain young fish by the thousand, more or less, according to the zeal and the efforts of the various fishermen in whose charge they are. The food is always the same during the first two months, small shrimps assorted, furnished two or three times a day; later, small shrimps such as are gathered with small purse-net attached to the end of a stick, at the sources of brooks, and in the large basins; for these crustaceans multiply wherever the water of the Devil Rock Brook is found.

Although trout placed in rivers consume an enormous quantity of these small shrimps, a great many remain attached to cresses and other aquatic plants. The positively prodigious quantity of small shrimps in the lake, the sources of the brook, and the large basins has so far not allowed me to think of raising these crustaceans in the rivers, and saves the trouble of transferring the trout alternately from an exhausted river to one still containing many of these small shrimps.

Our young fish remain in one place from March to September, and they are fed two or three times a day, as their needs seem to require it; and it is a curious spectacle to see them in dense masses pursuing their living prey. The quantity of small shrimps given to the fish two or three times daily weighs 5 kilograms (about 11 pounds). Having carefully counted the number of shrimps contained in 5 grams (about ⅛ ounce), and found this number to be 672, the total quantity of shrimps fed to the fish in a single day is not less than 672,000, or 4,704,000 per week.

The importance of the fact that this food is furnished free of cost will easily be understood; and the circumstance that it is quickly distributed all over the basin renders it certain that all the young fish will get their share of food. One-third of the food is served to the trout in the stone basin, where the trout of the season of 1886 may now be seen. Such is the result of confining the fish for sixteen months.

No sun, no vegetation, no hiding places, no quiet retreats along the banks; and in spite of these conditions, which a theorist would consider disadvantageous, these trout measure 18 to 22 centimeters (7⅛ to 8¾ inches) in length. And to what is this owing? Simply to the abundance of food and the impossibility of finding hiding places. The crustaceans are devoured as soon as they are put in the basin, as there is no place where they could hide. It would be hard to find yearling wild trout as strong and fat as those which have been confined in the basins ever since the umbilical bag has been consumed.

Since the month of October last, the piscicultural establishment at Piedra has been rented by the Government. At this time there may be seen at the raising-basin thousands of this year's trout which have already reached an average length of 7 centimeters (2¾ inches). These basins swarm with crustaceans, and nevertheless the three daily rations are never omitted. If one asks the fishermen as to the harvest of small shrimps, they invariably answer: "The more we take, the more there seems to be."

If the Government will construct inclosed basins on the existing model, it might try to acclimatize exotic species without fear of hybridization, which is an important point.

Mr. Raveret-Wattel points out the way to re-stock the rivers not only with young fish, but also with trout eight, ten and fourteen months old, as is done in Scotland with

those called yearlings. I entirely agree with Mr. Raveret-Wattel and the Scotch pisciculturists. If there is war, soldiers should be sent out, not babies; it is not the number which assures success, but the age and valor of the soldiers. Leaving this figure, which, however, shows the reason for employing yearlings, I venture to assert that if this system gains ground, the old system of stocking rivers should also be abandoned at Piedra, and the new system introduced. There will be no lack of food for the yearlings, for in digging out new ponds fed by the Devil Rock Brook it will be found that after two months they will be filled with cresses and other aquatic plants; and underneath these plants large numbers of small shrimps will be found, as has been the case in all ponds which have been dug, where many millions of these small crustaceans are caught every year.

In some places where the water freezes, the reproduction of the crustaceans is possibly suspended for some time. I cannot state this with absolute certainty, for I have not had occasion to make the necessary observations; but it seems to me that ice would not favor reproduction. In the lake and in the Devil Rock Brook the temperature, even during the severest winter weather, never falls below fifty degrees. This is really a spring temperature and I have with my own eyes seen small shrimps reproducing in winter as well as during the other seasons of the year. I doubt whether there is any other place as highly favored by nature for raising salmonoids, and also cyprinoids (tench, barbel) and crawfish.

Where the small shrimp is not found and the water contains particles of lime, attempts should be made to introduce it and favor its reproduction.

(Bulletin of the U. S. Fish Commission, 1887, p. 203.)

SELF-REPRODUCING FOOD FOR YOUNG FISH.

By Frank H. Mason, Consul.

Every person who has been interested in the artificial propagation of fish, and particularly trout and the several other species belonging to the genus Salmo, knows what care and labor are necessary to carry the young fry through the period immediately following the absorption of the umbilical sac, and to bring them to such a stage of maturity that they can be safely turned loose in open ponds or streams to shift for themselves. The mere hatching of the eggs involves no difficulty, and, under fair conditions, is ordinarily so successful as to make the propagation of fish in almost any quantity an apparently easy matter. But with the commencement of artificial nutrition the serious part of the task begins, and it is usually a small percentage of the swarms which are hatched that reach the maturity of yearlings, at which period the dangers of infancy are past. During the intervening months it has been customary to feed the young alewives on curdled milk, coagulated blood, finely-hashed meat and liver, grated yolk of eggs, macerated brains of animals, etc., the preparation of which, and the frequent feeding of the dainty little creatures, involves constant and more or less costly labor. Moreover, none of these forms of nutriment have been found entirely satisfactory, for the reason that they are all distinctly artificial and different from the living, organic food which nature provides for those species of fish during their tender, infantile period. The difficulty of providing proper nutriment results often in turning out the young fry into open water too early, when the temperature of the stream or pond is so much below that

of the tanks in which they have been hatched that they perish by thousands from chill and inanition, without making an effort to find natural food in their new element. Accordingly the problem has been to devise a natural, self-reproducing food, so easy and certain in preparation that it may be cheaply and abundantly provided, and thus facilitate the maintenance of the alewives during the first ten or twelve months of their existence, by the end of which time they should be so strong and active that a large majority may be relied upon to survive the struggle for life in larger waters.

The result seems to have been fully attained by a discovery made several years ago by Mr. F. Lugrin of Geneva, and practiced since 1884 in the piscicultural establishment at Gremaz, in the Department of Ain, in eastern France. As this process has been examined and approved by eminent experts, sent especially for this purpose by piscicultural societies of England and other countries, it is thought that some account of it may be of interest to the large and rapidly growing class of fishculturists in the United States.

Mr. Lugrin was for many years a practical fisherman on Lake Geneva. He noted the steady diminution of the more important species of fish in the lake, and sought to ascertain the cause He gradually reached the conclusion that the germ of the trouble lay in the growing scarcity of minute crustacea and larvæ which are the natural food of the trout and other fish, especially during their first months of nutrition.

After elaborate experiments, he hit upon a system by which Daphnia, Cyclops, freshwater shrimps (Gammarus pulex), etc., could be bred in countless myriads at merely nominal cost. The hatching and rearing of a generation of these minute creatures is the work of from twelve to fifteen days, and as the process may be repeated—or rather repeats itself—again and again in the same water, the problem would seem to be solved.

Whoever has watched from a place of concealment the trout feeding in an American stream has admired the adroitness with which they work down stream, raising with their noses the up-stream end of flat stones until the current, catching underneath, aids the clever little forager to turn over the stone and expose the minute larvæ and crustacea on which he so voraciously feeds. It is the purpose of the process now under consideration to raise by artificial means these same species of organisms, and in such quantities that the young fry may not only be abundantly fed in tanks or small inclosed ponds; but ample supplies provided for enriching larger streams and ponds where, for some reason, the natural supply may be insufficient.

The apparatus is simple, and visitors properly introduced have no difficulty in seeing the entire establishment at Gremaz, which occupies a gently sloping piece of ground, about six acres in extent and watered by three springs, which yield collectively about 500 gallons of water per minute. The tanks are rectangular excavations, about 120 feet long by 12 in width, with a depth of 5 feet. The ground being of a gravelly character it was neccessary to line the walls and bottom of some of the tanks with cement in order to retain the water, but in close clayey earth this would be needless, and the natural dirt bottom, if not to muddy, would be preferable to cement. The tanks have the same general level and are divided by sliding gates of wire gauze sufficiently fine to prevent the passage of the fry. Thus far all is simple and obvious. The process of Mr. Lugrin. which has been patented in several countries, consists in spreading upon the bottom of these tanks a material inpregnated with the elements necessary to produce spontaneously a limitless number of Daphnia, Cyclops, Limnea, as well as fresh-water shrimps, and the larvæ of various Ephemera which form the natural aliment of trout, and other Salmonidæ at all stages of their growth. Once constructed

and impregnated with this producing material—which is of trifling cost—these tanks go on with their work automatically and indefinitely. The water from two to three feet in depth, being left undisturbed two or three weeks, is found peopled with swarming myriads of minute organisms of the species above named. Twenty thousand trout a year old, or three thousand two years old—which last should average about one-half pound in weight—are considered sufficient for a pasture of that size, and the avidity with which they rush to occupy and ravage their new feeding-ground is a delight to the pisciculturist. If the propagation has been ordinarily abundant these 20,000 young fry or 3,000 yearlings will subsist royally in a tank of the size indicated for an entire month. They will eat on an average 20 to 25 pounds of food per day, or 600 to 800 pounds per month. Careful experiment has demonstrated that each tank at Gremaz will produce 650 to 900 pounds of Crevettes (fresh-water shrimps), to say nothing of the myriads of Daphnia, Cyclops, and other species produced in the same water at the same time. When, at the close of the month, the tank has become depleted, the gate is opened and the fish driven like a flock of sheep to new and similar pasture. The first tank, being closed and left in quiet, immediately begins the process of reproduction, and at the end of two or three weeks is swarming again with the varied minute organic life which far surpasses in value, as food for fish, anything that has been yet devised by man. Thus the simple, inexpensive process goes on from year to year, the fish always healthy and vigorous and larger at two years old than those artificially fed are at the age of three years. Yearlings bred in this way are strong and capable of making their way in any open stream or pond supplied with food and suitable for their existence. One thousand of such yearlings have been found more effective in stocking a depleted trout stream than fifty thousand young fry turned in, as has been so often done

heretofore, in order to get rid of them at the tender age when artificial feeding first becomes not only a necessary but difficult and troublesome. For these tender nurslings all open water, particularly when inhabited by older trout or other voracious species, are beset with a thousand dangers which the vigorous yearling is able to escape.

It is evident from all this that the system practiced at Gremaz is equally applicable to the industrial raising of trout and other fish for market and to the restocking of streams and ponds for purposes of sport. In the first case it is only necessary to provide a series of tanks or small ponds from one to another of which the fish can be changed monthly, as herein before described, until they reach a marketable size; and it is to be remarked that trout raised by this method have the natural firmness and flavor of wild fish, and not the flabby degenerate character of those which have been fed on liver, offal, and other unnatural, degrading food. Once prepared, a tank or pond is permanently productive. However voracious the young fish may be, they leave the bottom of the water still peopled with myriads of parent organisms which reproduce so rapidly that, before the end of a month, the placid water becomes clouded with swarming millions of their progeny. The fecal matter dropped by the fish during their month of occupancy is sufficient to maintain the fertility of the bottom, and thus the system, once established, becomes automatic and self-sustaining.

A single attendant can have the care of a large establishment, his only duty being to drive the fish periodically from one feeding ground to another and close the gate behind them, as a farmer changes his flocks from one pasture to another.

It remains to be explained that while the Daphnia, Nais, Cyclops, and other extremely delicate species can be profusely grown only in still water, the fresh-water shrimp (Gammarus pulex) grows abundantly in living streams. At Gremaz rivulets are provided which

flow from the springs into the tanks and carry away the overflow. These rivulets, the bottoms of which have been impregnated by the Lugrin system, are filled with cresses and other water plants and produce the minute shrimps in such abundance that they are gathered daily in panfuls by a few sweeps of a gauze scoop-net and fed to the fish in the swarming tanks. This part of the process is easily applicable to natural streams where a sufficiency of food does not already exist.

As to the applicability of this system to American pisciculture, there is apparently no room for doubt or question. The same natural conditions which exist at Gremaz can be found in nearly, if not quite, every State in the Union. The same food which is produced there may be used in growing nearly every species of fish which is artificially reared in the United States. American brook trout, the rainbow trout and California salmon thrive admirably in the tanks at Gremaz.

To conclude with the verdict of Prof. Francis Day, who, in October last, came specially from England to investigate and report upon the system which has been so successfully established there:

"When I remark that a tank 35 meters (10 feet) long by 3 (10 inches) broad, and 40 centimeters (1 foot 4 inches) deep, and capable of containing 20,000 young trout can be fully stocked with food in fifteen days, so as to be able to sustain the residents for one month without any additional supply, I cannot help thinking that Mr. Lugrin has solved a difficult problem, and that his mode of cultivating the natural food of fishes will prove a great and lasting benefit to fishculturists."

MARSEILLES, February 25, 1888.

The following discussion then ensued:

MR. MAY—I want to call attention to the fact that this paper that was published by the United States Fish Commission, is largely theory. The man who says that from one cubic foot of water he can raise enough of the daphnia and crustaceans to feed a thousand trout, I should like very much to see him do it. As for sweeping a light net over watercress and getting enough to feed, it may do very well for the man who raises a thousand or two, as most fishculturists in Europe do; but if I should ask for ten pounds a day! Angle worms are no doubt good food, but how am I going to get them? If I want twenty pounds of little crustaceans, the little water flea, (the daphnia) and others, where will I get them? Or to collect twenty pounds of snails a day! it would cost more than anything I know of. The food question, as I have said before is a vital one in fishculture. Most places can get cheaper food than we get, right near New York City, where there is a population that eats most everything eatable. In a paper which I will read by-and-by, I show that we have tried beef liver, which is very expensive here; we cannot get the hazlets of sheep, as they are called, because there is a large poor population here that buy them up. But I would like to see some practical man come forward and say that he has raised ten thousand trout and found enough of this natural food by sweeping a mosquito net over some watercress or something of that kind, and get ten or fifteen pounds of it during the day. I am an unbeliever in it, as you will probably see by this time.

MR. FAIRBANKS of Illinois—I did not come here with any idea of saying anything on this subject, but these papers have interested me very much indeed, and have been right in the line of what I am doing.

The remarks of Mr. Mather I regard rather as a challenge. I have at Lake Geneva, Wis., some trout ponds which I commenced there about fifteen years ago. I

began in the usual way of making ponds, and raised a good many trout by feeding curds, etc., as is usual. I am fortunately located on the side of a hill, which is all springs: dig anywhere almost, and you find a large spring; and I conceived the idea of making some natural ponds, and I have now some twenty-five ponds, varying in size from one hundred to three hundred feet in length and fifty to seventy-five feet in width. Some of them are smaller; some round, a hundred feet in diameter, perhaps. Scoop up an earth bank at the lower side, and let the spring come up and fill it. Some of them the weeds grow up in them naturally. Others, I take the weeds out of the little stream or outlet—I don't know the name of the weed, it is not the watercress that the freshwater shrimp inhabit; there is a little, low, close freshwater weed that fills the pond full almost, I take it out of places where it is already growing and put it in other ponds. That weed is alive with the freshwater shrimp, in its natural condition. I took out quantities of it and put it in these ponds, and they have filled up with it. I do not touch them or clean them out, but let it grow. I raise all my fry without a particle of food, until they are yearlings. I put in a pond 50,000 good healthy fry. I never touch them, never feed them, never look at them until they are yearlings. Some of them grow to six inches. This is a pronounced success, and a practical one; one which I am doing year after year.

MR. HOXIE—I would like to ask what proportion of those little fry grow up to yearlings. If you put in 50,000 fry, how many yearlings do you get?

MR. FAIRBANKS—I do not know that I can arrive at that. It is pretty hard work to count fish of that size. But all that I want. I should say fifty per cent. of them, as a guess; fully as many as that. Fully as many as I ever grow by feeding artificially; in fact more. After they arrive at yearlings I transplant them. But certainly you can raise in a natural pond by growing the weeds

and everything accumulating in there, and the natural food growing there, you can raise enough to take care of your yearlings without any trouble whatever, and that is the most important time. That is the time I fully agree with the paper in relation to transplanting. But I would not put out in any stream fry; I should raise them in these natural ponds until they are yearlings and then transplant them.

The question has bothered me a good deal. I have thought much about it, about trying to propagate enough in other ponds to feed the fish after they get older, and of course I have been interested in those papers which have referred to that. I have my doubts, however, of doing that upon a sufficient scale to feed larger fish. The fish are very voracious and need a great deal of food. But the fact that you can take care of the young fish, is of itself a very important question in trout culture. Make more ponds; plant the weeds and the stuff in them; put in the freshwater shrimp and the other crustacea, that will grow according to the location and the section. You can raise food for the young fish without any trouble whatever, and get your fish up to yearlings and then transplant them.

I have also experimented on raising other fish than trout; and some three or four years ago I gave the result of my experience in Lake Geneva in putting in the salmon trout. We have expended a great deal of money in Western States, in Wisconsin, Illinois, Iowa. The Fish Commissioners were very enthusiastic in the matter of taking the spawn of the salmon trout from the great lakes and hatching them and putting them into the smaller lakes with which those States abound. But I think it has been a failure all through. I made the experiment in Lake Geneva, which was a lake particularly adapted. It is of a character like the lakes of this State—Hemlock Lake, Cayuga Lake and those other lakes. A deep water lake, 150 feet deep, perfectly pure.

They have in them (the sysco) the natural food of the salmon trout, in its mature condition. And I thought it was particularly adapted to the raising of the lake trout. I pursued it for five years; putting in about half a million every year, of healthy young fry; hatched them, raised them, brought them up, and then dumped them into the lake. And I never have seen any sign of the salmon trout in that lake of any size. Not even the fry that I put in, or fish of six or eight inches or a foot long, or any size; never any sign. And the reason of it, I followed it out after a while, to my notion, it was entirely the lack of food for the young fish—for the fry. In the great lakes, in all these New York lakes, where the salmon trout is indigenous, where they have increased them by stocking, there are ledges of rocks, or reefs, about which the fish spawn. About those rocks is some small animal life, which I have never investigated to see what it is, but it is evidently something on which the young fish live until they are large enough to eat other fish. In this Lake Geneva there are no ledges, no rocks, and consequently no food for the young. Evidently every one of the young fry put in there simply starved to death. Demonstrating that it is absolutely useless to put fish into waters where they are not indigenous, unless you supply the food. That is the point on which the money should be expended in fishculture in my opinion. First find out if you can furnish the food for the young fish—and the mature fish too, for that matter. But until you can do that, do not waste any money on hatching, raising and distributing fry.

DR. KEARY—The trout that you experimented with is the common brook trout?

MR. FAIRBANKS—Yes. One other idea. The gentleman said that he noticed there was abundance of freshwater shrimp in all trout streams. That is true. That is what the fish are there for, to eat those shrimps. But there are just as many good streams for growing trout

where there is no food, but which can be put there artificially; and plenty of springs and streams where there is no food but which can be cultivated there; for everything has been cleaned out, in cleaning up the landscape, and the grounds the streams have been cleaned out; they are all cleaned, there is nothing left in them. But you don't want to pay much attention to the appearance of the stream; if it is choked up and full of weeds, all the better; let them grow, then the trout will grow. You can make hundreds of trout streams where you haven't any now and where you haven't any trout because there is no food.

MR. MATHER—I fear I did not make myself exactly clear on this question. I agree with Mr. Fairbanks on this natural food business to a certain extent. But in his ponds, he cannot put in more than a certain number than that will support. At the station of the New York Fish Commission which is in my charge at Cold Spring Harbor, I have one reservoir away up the hill, where we grow watercress, and the water flows down into another one which supplies the hatchery. This lower one is between three and four hundred feet long and from thirty to fifty feet wide. We have put in as high as 15,000 fry there and we have put in as low as 8,000, every year; and the highest we have ever taken out of it I think was 5,000. In the fall we usually draw it down, in September, and get out everything that we can, and we have from one to five thousand trout that are grown upon natural food which has not cost us a cent. But if we should attempt in that water to carry it on on a larger scale, and put a 100,000 fry in there, it is a question whether we would take out any or not.

MR. FAIRBANKS—In this lower pond is there watercress?

MR. MATHER—No, not much. There is no cress in it, but there are other plants, and it is full of natural food; but we get a few fish that have not cost us any-

thing there. Now, if we should undertake to force it, we probably would not get as good results.

But I am speaking not of the little fish places in Europe, where they turn out 5,000 in the course of the year and think they are doing well. Suppose you want to turn out a half million a year. It is going to facilitate you to get food for those fish when you want it by the pound, or ten, or twenty, or fifty pounds of natural food. I don't know how to get it, and I don't think that any man does.

MR. GILBERT—I would like to say while we are on this subject, that where the food of trout can be purchased for a cent a pound, it is hardly worth while for a man to spend the time, or even employ labor to get the natural food. It will cost more than it will to buy it.

MR. FAIRBANKS—Natural food makes a great deal better fish.

MR. GILBERT—That is a question on which there are many differences of opinion. We had a legislative committee down to my place and we gave them a trout dinner, and they were all artificially fed trout. One of the gentlemen of the committee afterwards was presented with some natural fed trout. He said a few days afterwards that he preferred artificially fed trout. So there is a variety of opinions about that.

But in regard to food, I am feeding now about a thousand pounds of trout a week, my young fry of last season's hatching. We begin to feed in April, about fifty pounds of liver a day. To get natural food to supply that demand would cost a great deal more.

MR. CLARK—You are feeding the fry?

MR. GILBERT—Yes, the young fry.

MR. CLARK—That is, year old?

MR. GILBERT—No, the young fry of last winter's hatching.

MR. CLARK—A year old last spring?

MR. GILBERT—No; an inch and a half long; fry hatched in February.

MR. CLARK—How many have you?

MR. GILBERT—About half a million. So in order to raise more, you will require too much natural food; I don't think it could be secured by any natural means.

MR. FAIRBANKS—You can do it with fifteen or twenty natural ponds, if you have got the space for them, one hundred feet in diameter. You can run your water from one pond to the other.

MR. GILBERT—A man has not the facilities.

MR. FAIRBANKS—I was going to suggest to Mr. Mather, he has one pond there and runs the water from that into another. If you have got the room to make half a dozen of these ponds you can raise just so much more fish in them. And your natural food will take care of the fry until they are a year old, probably.

MR. HOXIE—In regard to the quality of the fish, whether fed on liver or natural food. I will just tell you a story. We raise artificial trout and we have also brook or wild trout. I have been in the habit every spring of sending to a friend a box of trout all cleaned and packed in ice, early in the spring, as early as April. Well, the gentleman wrote me that he had received the trout and they were very fine, but he did not think they were quite up to wild trout. Perhaps a couple of months afterwards he and his son were up to my place fishing. I said: "Mr. Hazard. I have got a nice joke on you; those trout I sent you, I heard that you remarked they were not quite up to the brook trout, and I took particular pains to go up to the little lake and bait my hook with worms in the old fashioned way, and catch those trout." He was surprised, and said he was going to test it the first thing. He always gets a trout dinner when he comes up to my place; so he went to my pond, and got some wild trout and marked them by snicking the tail. Then he went to the other place and got some tame trout. Mrs.

Hoxie cooked them, and he set to work to test them. So his son covered his eyes and he took pieces of each, and he got the thing reversed right around, and declared that the tame trout was the finest trout he ever tasted! The artificial trout was the one he picked out for the wild trout. And he said that he would never say again that a man's taste was keen enough to tell the difference.

MR. POWELL—In regard to this question of food for fishes, being one of the Commissioners of the State, I represent and we get applications many times for five, or six, or eight cans of trout fry. The question is whether it is wise to give them so many, whether there is food enough for them. We get applications for five or ten cans where there is not enough for two. It is an interesting question which has been put to me before by correspondence from different parts of the country. I would like to have some persons who are more familiar with this question to express their views.

MR. FAIRBANKS—Suggest that the applications give you some account of the stream they are going to put the fry in, and the food that is there. If they are interested enough for five or ten cans they ought to be interested enough to give such particulars.

MR. POWELL—The people are anxious to get as much as they can for nothing. They use fictitious names for themselves and for the streams also. If we do not send what they ask for, we are abused day in and day out. Only last night I received a communication from the Senator of Lucerne County, in the State I represent, complaining that they do not get enough trout fry.

MR. FAIRBANKS—There ought to be an investigation to arrive at some sort of knowledge as to the character of the stream. It might be as well for the commission to spend half of their money in investigating the character of the streams.

MR. POWELL—The point was put before our legis-

lature. It was said that we ought to have enough power to know where these fishes go to. We are abused every day in the week, you might say, when the season comes around for these applications. They apply to the other commissioners and then to me, and all the fish go into one stream. As to the stream, the chances are there is not more than enough food in it to feed one can of trout; and why should twenty go in it?

MR. FAIRBANKS—They should not. It is a question for your commission to decide. Your commission can exact from the people who make the applications, a sworn statement, or a statement from some well known man in relation to the character of the stream, the length of it, size of it, and the sort of food there is in it.

MR. POWELL—I went to the highest authority of our State yesterday for an opinion before I came here. We have a large number of applicants who apply for trout: our blanks simply say "on a public stream," and they declare they are public streams; and so soon as they get the fish, those streams become private streams, and nobody can fish in them. It is raising a very interesting question in our State.

MR. FAIRBANKS—I would extend your series of questions a little further to get information that would be valuable to your commission.

MR. REYNOLDS—I suggest that the commission should distribute some tracts to improve the morals of the people—not to lie about a fish until they get a fish.

MR. GILBERT—I think the application should be accompanied by a sworn statement that the fish are to go into public waters. A law should be passed to that effect.

MR WHITAKER—I have been quite interested in some parts of the discussion that has just been raised. The points that have been raised are questions we all meet in our work. In our own state we have taken occasion to secure the best general results for our own work, by arming ourselves with facts in regard to the waters

of our State. Since 1885 we have conducted each summer a systematic examination of our inland waters, particularly with reference to the lakes. Each lake is examined, its surroundings, temperature at bottom, the condition of the water with reference to food, the inlets and outlets, and everything pertaining to that; many other things I cannot now remember. In addition to that, practical men are asked to recommend the fish to plant, such as they believe will exist and thrive. It has been of immense advantage to us. A rude map is drawn upon the back of the report, with the soundings noted upon it. They are bound in book form, and we have them for every year since we began. In addition to that, in a general way we familiarize ourselves with the streams of the State. So that we can tell with tolerable accuracy whether the fish that are applied for are likely to thrive and be heard from again. That eliminated, we have the same difficulties spoken of here, of people making statements in reference to the condition of their waters; whether they are open or private, that is upon every application. Wherever we find that those matters are falsified, in future so far as we can guard against it, those applications are refused. But in this way we have this advantage that we had not before we adopted a system. It is quite a common thing for a man who has a water in which he takes a pride, to have it stocked with something, he does not know what, but he wants something. We want to entertain a due regard for the success of our work, and after an examination of our reports that are filed away, if we find that the lake he applies for is filled with bass, he will apply for 50,000 brook trout to put in that lake, we will deny it, and we will say you are only putting the lamb inside the lion.

We find that in this way the results of our work have been very much improved. We shall continue to follow this plan. And as it has been said here, of course there are times when we find people who make applications

through other private parties, apply themselves for the same streams. We determine all those things ourselves. When it comes to the closing of planted streams, the only way to be done with that, is to take it to the Supreme Court of the State, because it is a conflict between the interests of the public who have planted those waters for the public to fish in, and private individuals, and the courts will settle it. And I believe they will settle it in the line that if the public have enterprise enough to stock those waters for the public benefit, they are entitled to fish in them.

MR. JAMES—I think all this goes to the point that in supplying fish you must supply food, and in such quantities as will let these varieties of fish survive. Then comes in the matter of finance in connection with this: Will it pay to put in a certain variety of fish without supplying that food?

It is a bad financial policy. Those who are propagating fish, who are using the food for fish for supplying the market, must necessarily go to such expense as will give these fish the requisite amount and the kind of food. But of course you have got to keep off the marauders, and only plant in such streams as will allow them to survive. There must be some streams for black bass, and some streams for bass; certain lakes for certain fish. The whole question resolves itself down to a certain circle of life. We know that food after it has passed through and been discarded by animal life, goes back into vegetable life, again to be taken up. And this growth of vegetable life supplies food again for the minute animal life, until finally that circle is completed by the furnishing this nitrogenic food for the plant. So we have a circle in this way. If we are going to propagate fish with any degree of success, we must maintain this circle of life. Those that have the supplying of these fish must ascertain what kind of food, in what quantities, must be placed in those streams or be in those streams, other-

wise it is useless, and you throw your fish away to die. Then you must remember that the quantities of food will increase with each year. You put the small fry in and they require very little animal food; but as they grow in size from three-quarters of a pound to two pounds and a half or more, the greater the demand for the food supply. Therefore that proportionately increases as you go on. The larger your fish, the greater the supply of food needed. The larger your fish are the better price you get for them in the market. So that the whole matter is a matter of circle in finance, in the propagating and feeding of the fish.

MR. PAGE—There have been one or two points touched upon here, that I have some little information on which possibly may be of value. On this question of feeding the fish. Mr. Gilbert wants to know how much food it will take to feed 10,000 pounds of trout. It might be very easily inferred from Mr. Fairbanks' statement that that would depend upon the amount of water, and the size of the pond.

It happened last year at the station of the U. S. Fish Commission where I was, we raised something over nine thousand pounds of trout in a very small space of water: five ponds, eight by twenty feet, having fifty gallons water each per minute. Those fish measured from four to ten inches in length, I am safe in saying they were the largest trout of their age that have been raised in the United States. The food supply was very small, because the water was enormously rich in natural food, particularly in snails; and as you all perhaps know, snails will produce enormous quantities of eggs, and all trout are very fond of them; we allowed them to grow abundantly on those ponds and the snails propagated. The food given them was raw beef liver mixed with a mush made from ship stuff when the fry were very young; fed in the house five or six weeks on pure beef liver; then as they were put out in the pool in small quantities a little mush

was added to it until after they were five or six months old, the mush would be increased. I have gone over that cost very carefully, interest on the cost of the plant, labor and artificial food given them makes it well on to eight cents per pound of trout. To illustrate the advantage of that, Mr. Young Robinson, at Mammoth Spring, about two hundred miles from me, in Arkansas, is raising trout and is fortunate in getting fifty cents a pound for them. I hope there are no dealers present to take advantage of that. He could well afford to sell those trout at twenty-five cents a pound. I venture to state that, because Mr. Seal asks in his paper as to what it would cost to raise trout. I know it costs very much more in some localities; for instance, my friend Mr. Mather cannot afford to buy beef liver. We use it now on some forty-five or fifty thousand trout fry, fifty pounds of liver a week and about fifty pounds or seventy-five pounds of shorts.

MR MATHER—I would like to ask Mr. Page one question: If he has made any inquiries what it would cost to raise a yearling trout; or what is his opinion?

MR. PAGE—We raise our yearling trout at about eight cents per pound and turned out a little over nine thousand pounds of fish last year, or trout. Average cost of attention, food, interest on the plant, etc., is about eight cents per pound.

MR CLARK—Mr. Mather did not ask me, he asked Mr. Page that question. I would say that a short paper that I have, will give those figures, exactly what it costs to raise a yearling fish.

DR. BRADLEY—I will ask for information: I am connected with a hatchery. We hatch about from five hundred to eight or nine hundred thousand a year. We have trout, brook trout, living in the same lake with bass, and they do not eat each other up; we catch brook trout and bass out of the same lake repeatedly.

MR. WHITAKER—We avoid planting black bass and

trout in the same stream; we believe they would not thrive together, Also, there are so many streams that are well calculated for trout and are not encumbered with those difficulties that it does not seem worth while for us to attempt to run that risk. Another thing, the question of food is a question there is no sort of doubt about with reference to pond reared fish, it is worthy of consideration But in this country where nature has provided so abundantly in most of our streams at high latitudes, it is hardly worth while to entertain the question of food. The caddis and the shrimp abound in those streams and lakes.

MR. BRADLEY—I simply wish to make the point that those fish live and breed in the same lake.

MR. QUACKENBOS—I agree with what Dr. Bradley says. On Seneca Lake, N. H , we have bass and trout together. But that is explainable on the ground that they are not in the same water at the same time, consequently they have both quantities of the natural food. Those are peculiar conditions to the water. The trout are in the deep, cool water and the bass are on the surface; and I never have found trout inside the bass. I think also the bass have destroyed the enemy of the trout, namely, the perch.

MR. PAGE—My experience leads me to believe that the old bass eat the young trout, and the old trout eat the young bass.

REARING FISH FOR DISTRIBUTION.

By Frank N. Clark.

At the twentieth annual meeting of the American Fisheries Society held in Washington, D. C., in May, 1891, I read a short paper on the rearing and distribution of trout from the Northville Station, giving the plan pursued, and some of the results attained. The members of the society present at that meeting will remember that the subject brought out quite a discussion concerning the practicability and feasibility of rearing fish for distribution. One of the arguments introduced against the work was the expense, some thinking the outlay would be so much greater than in the case of planting fry; others that the trout accustomed to liver would not adapt themselves to other food. At that meeting I promised to give some figures and facts relating to the expense of rearing trout to the age of one year at the Northville Station. It must be borne in mind that the food used at this station for feeding fry is wholly beef's liver, bought from the slaughter houses in Detroit and shipped by express to Northville. For the years 1890 and 1891 we reared and distributed 250,000 yearlings; about one-half of them being lake trout and requiring at least one-half more food than brook, Von Behr, or Loch Leven trout. The cost of the food for this lot of fish was $740.00, making the cost for food per 1,000 $2.95. The cost for labor based on actual time was $600.00, or $2.40 per 1000. In addition to this amount there should be added about $3.00 per 1,000 for expressage, draying and superintendence, making a total cost, when ready for distribution, of $8.35 per 1,000, or less than one cent each for yearling fish, and with facilities for rearing four times as many the cost as to labor would be much less per 1,000.

Not only is the arguments from figures, strongly in favor of yearling plantings, but those drawn from well-

known facts also speak with no uncertain sound; for instance: the condition of fry when planted is such that they must have food at once or they perish, while on the other hand the yearlings are in condition to go without food for a considerable length of time. Also one of the greatest losses suffered in planting fry is their being devoured by larger fish, which loss in planting yearlings we do not find as great. To test this difference, I placed 100 fry in a tank 8 feet long, 2 feet deep and 18 inches wide, containing twelve yearlings; in another tank of same dimensions, I placed twelve yearlings with six three-year old trout, this for the purpose of noting how soon each would disappear as prey. The fry were all all gone in six hours, while in the tank where yearlings were with the three-year olds, only two were gone the second day. Remember, please, that our argument rests upon actual experience and not theory.

Another argument we have to meet is regarding the matter of distribution, and we can say, in distributing yearlings to-day, we have no more difficulty in transporting them than we do fry. In our distribution this last winter, by making fourteen trips with the car and carrying 80,000 trout from two and a half to seven inches long, there was an actual loss of 1,738, and of this loss 938 occurred on one trip in which some accident occurred with the tanks, making a loss of about two per cent. This clearly answers the question as to transportation. Can the distributers of fry inform us of the actual number planted or the actual number lost in transit?

The work of planting yearlings is no guesswork, as the fish are counted into the tanks when put aboard the cars and counted out when planted, the captain of the car receipting for the fish and then again having the applicant receipt to him for the actual number planted.

An objection urged against planting artificially fed fish is, that when turned into waters to be stocked, they are naturally looking for the food they are accustomed

to and will not readily take the live food that may be in the stream. Has any fishculturist ever cast the fly in a pond of large fish that have been fed artificially and been unable to get a rise, or has he thrown grasshoppers or in fact any live food of whatever nature but it would be readily taken?

If it could be proven—though it cannot—that natural food is indispensible to the rearing of yearlings for distribution, then under circumstances that are favorable, the food for growing fish may be bred with as much care as is used in breeding the fish, and undoubtedly with far less expense than in feeding liver. This, however, would naturally require a large area of ponds and a large supply of water.

With the work of procuring eggs, laying them down in the hatchery and turning out the fry, we have long ago passed the experimental stage and have arrived at the practical side of the question with the salmonidæ. It only depends on the question of parent fish as to the number of fry to be hatched; neither does it require a scientist to do this branch of fishculture work, but a good, practical man. Therefore, with the rearing of trout to-day, the principal question that should occupy the minds of advanced fishculturists is: what should be used for food and how to procure it.

Every observing and thoughtful fishculturist knows that many of our inland lakes have been planted with hundreds of thousands of whitefish fry and only a very few have been stocked. If we raise the whitefish fry to be one year old and plant them in these lakes, is it not possible and probable with the results before us, that we may be successful in stocking many more bodies of water than the fry work has accomplished? At any rate, is it not worth the trial? Experiment by practice is part of a fishculturist's work.

One of the proposed improvements at the Northville Station is that of constructing a rearing pond for white-

fish and furnishing them with natural food from the creek. And we have every promise of success in such an undertaking.

In conclusion, I cannot refrain from expressing my deep solicitude concerning this question, for more is dependent upon the successful and increased planting of yearlings than even practical fishculturists think for. To my thinking, much of the future of fishculture is dependent upon it, and I trust that all present will enter heartily into, not only a discussion of the question, but also a practical testing of it.

At its conclusion, Mr. Fairbanks said: What do you find the natural food of the young white fish to be?

MR. CLARK—I did not say I had found it. I think the food is in the water. I think the article of Professor Forbes enters into that subject more thoroughly than I could. He shows us what the natural food is.

MR. MATHER—What does your liver cost you at your hatchery?

MR. CLARK—Three cents a pound for beef liver.

PLANTING FRY VS. PLANTING FINGERLINGS.

BY JAMES NEVIN.

Mr. President and Members of the Fisheries Society:

For the past few years there has been considerable said by some prominent fishculturists, which has been taken up and discussed by the press against the planting of small fry in the streams; and that much better results will be secured if the fish are kept in the hatching house or reared in the ponds until they are some six or eight months old, and planted in much smaller numbers.

There are several States in the Union which have been engaged in fishculture and planting fry long enough to know whether their work has been successful or not.

I see by the *Detroit Tribune* of the issue of April

27th, that Mr. Clark of the Northville Station, in an interview with the reporter, made the statement that he would rather have 100,000 fingerlings than 5,000,000 fry to plant in the public waters, as the 100,000 fingerlings will bring forth better results. If Mr. Clark's statement approaches anywhere near the realms of accuracy or is approximately correct, I am forced to the conclusion that the States of New York, Pennsylvania, Michigan and Wisconsin must have a lot of idiots in the form of fish commissioners, looking after their piscicultural interests, as the 100,000 fingerlings can be reared and distributed for about one-third of what it costs to run a hatchery that handles 5,000,000 brook trout fry. The several governors of these States ought to have their attention called to this matter so that they could overhaul the commissions of their respective States for allowing such wasteful extravagance in the use of the public money placed in their charge.

I claim that we can stock a stream with fry if they are properly planted in the stream or some small rivulet tributary to it; and that there will more fish live and thrive in the wild stream than Mr. Clark or any other fish-culturist can raise in the hatching house.

If you wish to make a success of planting fry you have got to take great care in planting, and get them well up to the head waters. It is very seldom that you will find a stream but what has some spring tributary to it, and in these rivulets or springs, we always recommend the applicant to plant the fry. Some people are careless in this regard and will, for convenience sake, plant the fish at some road bridge crossing the stream. Nine times out of ten there is a large pool under the bridge, and at the season of the year when the fish are planted, the large fish seek those pools. Mr. Clark's idea is that his fingerlings are large enough to take care of themselves, but we all know the size of a trout when six months old—just large enough to

make nice bait for the larger fish—and in nine cases out of ten, his fingerlings are dumped out at some bridge, and the consequence is the little fellows, having been confined for so long a period and not knowing what it is to have an enemy, become an easy prey to the other fish. In case the fry, which has not lost the natural instinct of evading enemies, is planted near a bridge, they at once dart off to some stone or other convenient and suitable hiding place for cover, and I am firmly of the belief that fry planted in a pool with larger fish will have a much better chance of living to try the skill of some clever manipulator of the rod and line, than fingerlings would have under the same circumstances.

Some five years ago we planted 400 two-pound lake trout in one of our lakes at Madison. The following morning after the fish were planted, four of those same fish were brought to Mr. Dunning, the President of our Board, having been taken from the mouths of pickerel speared during the night; and I am of the opinion that not one of those fish lived twenty-four hours after they were set at liberty in the lake, and that they all became the prey of other fish. It was like placing a lamb in a lion's den for safekeeping.

The success of the Commissioners of Fisheries of the Badger State in stocking the streams of the commonwealth with brook trout fry, has been fully demonstrated. Brook trout were not known to exist in the streams in the central portion of the State until the Fish Commission was inaugurated, and the commissioners began planting fry; and it is in this section of the State that the commission receives the most credit. Here are some of the finest stocked trout streams there are in any State in the Union, and in a section of country where the streams are fished by thousands during the fishing season. I see by the *Milwaukee Sentinel* of May 11th, that one man took 7,000 brook trout out of one of these

streams alone last season. It was reported through the press that 5,000 brook trout were taken from the streams in the vicinity of Sparta, Monroe County, the first day of the open season this year.

It seems to me if the "Badgers" had to depend on my friend, Clark's plan of stocking a stream with from one hundred to five hundred fingerlings, that they would go fish hungry after the first day's fishing for the remainder of the season or until such time as the stream was replenished.

The people of the State of Wisconsin are well satisfied with the results obtained by planting fry. The only trouble is we cannot hatch enough of them to supply the demand, as Wisconsin is fast becoming a great resort for summer tourists during the fishing season.

I hope that the next annual meeting of the Fisheries Society will be held in Chicago, and at a season of the year when all those who are engaged in fishculture will be able to attend. Those who may have time and wish to take a short season of recreation and enjoy a few days' fishing, I will take pleasure in accompanying them to some of our famous trout streams, that they may view for themselves what has been accomplished in our State by stocking the streams with fry.

I enclose herewith a letter from the Hon. J. S. Bugh, County Judge of Waushara County, which speaks for itself for the success of stocking the streams of our State with fry. If we thought it necessary at this late day in the work of fishculture to offer further proof of our success in stocking streams with fry, we could furnish a thousand just such letters:

WAUTOMA, WIS., May 17th, 1892.

MR. JAS. NEVIN,
Supt. of Fisheries,
Madison, Wis.

My Dear Sir:

I have received your letter of the 14th inst., in which you ask me, first, to give you "an estimate of the num-

ber of brook trout taken from the streams of Waushara County, with rod and line during the past year, or years, since trout were first planted in those streams."

If you had asked me to enumerate the leaves on the trees, or the stars in the sky, I could as easily give you the number. When you understand that in this county there is the White River, the McCan Pine River. Willow Creek, Rochacre Ten-Mile Creek and many other streams with their innumerable branches, all trout-bearing streams, and fished by men, women and boys here and coming here from all over the State and even from as far east as Boston, you will readily see how impossible it is to even approximate the number. The estimate might be made in *tons*, but not in numbers.

Your second question, "whether trout were known to exist in streams in this county before being planted by the commission?"

I have heretofore assured you that there were none, and I now repeat that having lived here for over forty years and hunted and fished everywhere in this and adjoining counties, they could not have existed unknown to me.

I wish to say to the commission that no one thing has brought this county into notice and advertised it so much as our trout streams. Sportsmen who come here to fish all say, that, taking all things into consideration, the advantages of civilization and freedom from the annoyance of flies and mosquitoes, it is excelled nowhere in the United States.

Should be pleased to have you and President Dunning come up and see us.

Truly yours, J. S. BUGH.

When the paper was concluded, Mr. James said: I don't know that we come fully under that category. We have been engaged in a very hard work there, to try and keep people fishing out our streams, who have with wires and every conceivable arrangement endeavored to clean them out. We have now laws that will protect us some-

what; we are cleaning out the ground, and soon we will put such fish in such streams as we think will not interfere with one another in the way of devouring each other. We are aiming to accomplish this very object of bringing about a large supply of fish in our different streams. We do plant them as far as we can get into the springs. We send them off as far as railroads will carry them, and then send carriages up as far as we can and deposit the fry. We have as yet held on to the fry business. Mr. Ford will bear me out, I think, that our shad supply a few years ago ran down to sixty thousand a year, and I think last year it was in the neighborhood of three hundred thousand to four hundred thousand catch. So in our propagating the shad as we do there, by sending them up the river, we certainly are increasing the supply of shad in our Delaware River.

PLANTING TROUT AS FRY OR YEARLINGS.

By Fred Mather.

Mr. President and Gentlemen:

In the last report of this society, pages 11 to 13, this question was discussed in a small way, neither side having any figures to show the cost of feeding and planting a trout which was a year old. I am quoted as saying: "I do not believe that it is economy to raise trout" [for distribution] "to be a year old," and that belief has been confirmed by subsequent experience. The advocates of planting yearlings have had an inning and have ventilated their views in the newspapers and periodicals, but the other side has not been heard from, and, if I am not mistaken, this opening gun from our line will be followed by others of larger calibre. We believe that the best results will be had from planting trout as fry and will essay to prove it.

If a man wishes to plant an orchard he would like to

have trees that will give him a crop at once, and if he would stock a stream he naturally wishes yearling fish; hence the scheme of feeding trout until they are a year old commends itself to the anglers and also to their journals, but what they want and what we can afford to give them are different things. The nurseryman will give you several small trees for the price of an older one, and the fishculturist can give you a hundred, or more, fry, cheaper than he can raise and deliver you a yearling trout. That the yearling is worth many fry is true, for it has escaped a class of enemies that can only kill smaller fish, but the kingfisher can still take it, and does. I will not consider the question of the ability of a pond-fed fish to take care of itself, for it may be able to do so, and I propose to treat the subject squarely and strictly on what I believe to be its merits.

At the last meeting of this society, it seemed as if my position was unsupported to any extent, and this was not encouraging to one whose only object was the general good of fishculture, but months afterwards letters of approval incited an experiment in the cost of feeding young trout and a consideration of the expense of planting them; but it was not until the first of January last, that my foreman received orders to weigh and record the food of 16,300 brook and brown trout, the hatch of the previous spring. The record gives date, pounds of food, temperatures of air and water, and remarks on weather, etc. It covers the months of January, February and March, 1892, ninety-three days, on three of which we had no food. If it be said that these fish, so near a year old, would consume more food in the last quarter, the record shows that on twenty-three cold days the fish were not taking much food, ranging from four to eight pounds of horse meat, against fifteen or twenty pounds on other days.

During the previous quarter, October to December, I have the word of the man who cut the meat, that the fish took more food; for we have little cold weather on

Long Island before Christmas, and the record shows that the taking of food was influenced not only by the temperature of the water dropping below 40 degrees Fahr., but also by the temperature of the air and the atmospheric conditions. Therefore I am disposed to take this, the last quarter, as a fair estimate of the consumption of food during the year, for we started in with 25,000 fry which fed along from March to nearly the last of May, when the mortality began, the weaker ones died, and there is a great waste of food when so finely chopped as it is necessary to be for the "babies."

Horse meat has been spoken of and a digression may be pardoned to say that during my twenty-four years' life as a fishculturist, the question of the best and cheapest food for trout has been the leading one. Beginning with hen's eggs, which is the worst of all, the usual beef's liver, lights (lungs), heart, maggots, mosquito-larvæ, soft clams, *mya asenaria*, and salt water mussels, *mytilus edulis*, have been tried until, in November last, a man who kills wornout horses for their hides, bones and dog-meat, was found who delivers us clean, sound muscle, free from bone, of horse, mule, or cow that died in calving at the uniform price of four cents per pound at the station, and it is the best food for trout, and the cheapest that we have found. At this station beef livers from New York averaged, with express charges, seven cents per pound, *i.e.*, they cost fifty cents each and averaged ten pounds apiece, and the freight on the box cost forty cents whether containing one or three, and the supply was uncertain.

To resume: During the quarter mentioned we fed 16,000 trout, as follows:

January, ...	328½ lbs.
February, ...	376½ "
March, ...	435½ "
	1,140½

This, for ninety days, would equal 12.66 pounds per day, which at .04 cents per pound would cost a trifle over .50½ cents per day, or $184.00 per year for the 16,000 fish.

Divide this and it gives $11.55 per 1,000 fish.

Add to this the transportation. One man can take care of ten cans of fry for twenty-four hours, and each can will carry 5,000 fry or 30 to 50 yearlings, according to size.

Say, for instance, that you have 1,000,000 trout fry to plant. This will require one man for twenty days if he can take them in lots of 50,000, in ten cans of ten gallons capacity, each. Without counting railway fares his daily expenses, say $3.00, and his pay, say $2.00, would equal about $100.00 for the whole. Now keep this fry for one year and if you have good luck you may have 600,000 to plant. From thirty to fifty of these is all that can be carried in a can, and ten cans is as many as a man should be asked to care for on a trip of twelve to twenty-four hours, or 500 at one time, at the largest figure. This would require twelve men for one hundred days, and again throwing out railway transportation, would cost at the low average of $4.00 per day. per man, for wages and expenses, the sum of $4,800.00 and I defy any man to prove that the results of feeding trout to be yearlings, and then planting them, would be in any sort of proportion to the expense of food and transportation, which, added together would make a grand total that would be appalling to States with small appropriations.

Let us say that one yearling is worth ten fry, which has not been proven, and then compare the expense! Let us plant fry in sufficient numbers to allow for all losses and not waste our means on planting yearlings, a new notion which has been loudly heralded as a grand success but which cannot be proven to be so.

It has somewhere been stated that the U. S. Fish Commission had stocked some far Western Stream with trout

fry for years and no good results followed; a year or two ago some yearlings were put in and lo! the stream now affords good fishing! If fry cannot live in this stream we might ask how the stock is to be kept up? By planting yearlings each year when their progeny cannot live? Surely such a stream is not a good stream for trout and should be abandoned.

That those who have streams to be stocked will clamor for yearlings instead of fry is to be expected. They would like two-year-olds also, and if we would give them our old three-pounders they would be very happy; but, they should apply for their two-year-olds just two years before they need them, and give us twelve months to produce yearlings on natural food in their own streams without expense to the state.

When we count the cost of food, attendance and planting, with incidentals, such as ice, extra help, etc., it will be found that a yearling trout will have cost from six to ten cents more than it would if planted as a "baby" the year before. Of course the item of transportation is one that cannot be accurately figured for obvious reasons. A man may be gone from half a day to three days with ten cans of fish, costing from two to fifteen dollars for his labor and hotel bills, exclusive of railway fares, and the planting of yearlings cannot, it seems to me, begin to compensate for the great cost of rearing and planting them. The assertion has been made that it is the best method, and this has been repeated and reiterated until many people believe it. There are but few men in the country whose practical experience renders them competent to speak on this question, and I am assured that an overwhelming majority of them are in favor of planting fry.

N. Y. Fishery Commission,
Cold Spring Harbor, New York, May, 1892.

I append the records, mentioned, as received from the man who fed the fish.

FOOD CONSUMED DURING THE MONTH OF JANUARY, 1892, BY ABOUT 16,000 BABY TROUT HATCHED MARCH, 1891.

		Temperature.		
				Remarks—Mention any cause for not Feeding.
Date, 1	Pounds, 18	Air, 56	Water, 45	Fish feeding good, fed four times a day.
" 2	" 18	" 52	" 48	" " " "
" 3	" 15	" 38	" 47	Same, colder, fish dropped off feeding.
" 4	" 8½	" 19	" 40	Water colder and cloudy, fish feeding badly.
" 5	" 12	" 19	" 40	Fish fed between the hours of 8 A.M. and 5 P.M.
" 6	" 4⅛	" 28	" 40	Heavy snow, fish feeding poorly.
" 7	" 12	" 22	" 39	Weather clear, fish feeding better.
" 8	" 11½	" 10	" 39	Fish consumes more food from 12 M. until 4 P.M., when the water
" 9	" 12½	" 18	" 42	is down from 39 to 40 degrees Fahr.
" 10	" 10	" 18	" 39	Water cold, fish not feeding very good.
" 11	" 10	" 28	" 39	" " " "
" 12	" 15	" 34	" 42	Clear, fish feeding very good.
" 13	" 13	" 38	" 44	" " "
" 14	" 16	" 54	" 48	Warmer and clear, fish feeding good.
" 15	" 8	" 32	" 44	Snowing, fish feeding poorly.
" 16	" 4	" 16	" 38	Water cold and cloudy, fish feeding very bad.
" 17	" 9½	" 4	" 36	Clear, fish feeding better.
" 18	" 13½	" 30	" 42	Temperature of air and water taken at 7.30 A.M.
" 19	" 13½	" 44	" 44	Clear and warm, fish feeding quite good.
" 20	" 4	" 14	" 38	Cold all day, fish feeding bad, cloudy.
" 21	" 8	" 10	" 38	Clear, fish feeding better.
" 22	" 12	" 12	" 39	Trifle warmer, fish taking more food.
" 23	" 13	" 30	" 44	Refuse netted from ponds every day.
" 24	" 10	" 26	" 40	Cloudy and some snow.
" 25	" 12	" 30	" 42	Weather fine, fish feeding better.
" 26	" 3	" 10	" 40	Blustering and cold, fish feeding very bad.
" 27	" 00	" 04	" 35	Ponds frozen over, could not feed fish.
" 28	" 7	" 10	" 36	Ponds clear of ice, fish feeding fairly.
" 29	" 15	" 20	" 44	Warmer and clear, fish feeding good.
" 30	" 12	" 30	" 40	Blustering and some snow.
" 31	" 8	" 34	" 38	Cloudy and blustering, fish feed ng badly.
	328⅛ lbs.			

FOOD CONSUMED DURING THE MONTH OF FEBRUARY, 1892, BY ABOUT 16,000 BABY TROUT HATCHED MARCH, 1891.

		Temperature.		Remarks—Mention any cause for not Feeding.
Date, 1.....	Pounds, 12	Air, 26	Water, 40.....	Warm and some rain, fish feeding fairly.
" 2. ...	" 16½.....	" 34	" 42.....	Warmer and some rain, fish feeding very good.
" 3.....	" 7	" 36	" 42.....	Sorted and sized fish, fish wild, not feeding good.
" 4.....	" 14	" 26	" 40.....	Fish more at home in their new quarters, feeding better.
" 5.....	" 16	" 24	" 41.....	Clear, fish feeding very good.
" 6.....	" 8	" 18	" 38.....	Water cold and some ice in ponds, fish feeding badly.
" 7.. ..	" 12	" 18	" 38.....	Moderated by noon, fish feeding better.
" 8.....	" 14	" 34	" 42.....	Finished sizeing fish, weather warm and clear, fish feeding good.
" 9.....	" 14½.....	" 32	" 42.....	Fish would have taken more, but are getting short of food.
" 10.....	" 16	" 40	" 40.....	Weather warm and clear, fish feeding good.
" 11.....	" 10½.....	" 30	" 42	Snowing, fish not feeding so good.
" 12.....	" 13	" 20	" 38.....	Weather cold but clear, fish feeding fairly.
" 13.....	" 5	" 8	" 37.....	Blustering and cold, fish feeding badly.
" 14.....	" 13	" 10	" 38.....	Moderated by noon, fish feeding fairly well.
" 15.....	" 16	" 32	" 42.....	Warmer and clear, fiish feeding very good.
" 16.....	" 14	" 18	" 38.....	Cold but clear, fish feeding fairly.
" 17.....	" 11½.....	" 12	" 38. ...	Cold and part of the day cloudy, fish not feeding so good.
" 18.....	" 14½.....	" 14	" 38.....	Very moderate by noon, fish feeding better, clear.
" 19.....	" 14	" 20	" 39.....	Fish would have taken more, but the food was fat and stringy.
" 20.....	" 15	" 36	" 41.....	Warm and misty, fish feeding good.
" 21.....	" 15	" 32	" 41.....	Warm and some rain, fish feeding good.
" 22	" 18	" 34	" 42.....	Warmer and most the day clear, fish feeding very good.
" 23.....	" 17	" 32	" 41.....	Warm and clear, fish feeding very good.
" 24.....	" 18	" 34	" 42.....	Cloudy and warm, fish feeding very good.
" 25.....	" 4	" 34	" 42.....	Cleaned out ponds, water low and muddy, fish did not feed.
" 26.....	" 5	" 36	" 44.....	Finished cleaning ponds, water low until night, fish not feeding good.
" 27.....	" 14	" 36	" 44.....	Warm and clear, fish feeding good.
" 28.....	" 13	" 20	" 40.....	Colder and cloudy, fish feeding fair, some snow.
" 29.....	" 16	" 28	" 40.....	Warmer, fish feeding good.
	376½ lbs.			

FOOD CONSUMED DURING THE MONTH OF MARCH, 1892, BY ABOUT 16,000 BABY TROUT HATCHED MARCH, 1891.

		Temperature.		
Date, 1	Pounds, 11	Air, 30	Water, 40	Remarks—Mention any cause for not Feeding.
" 2	" 8	" 20	" 38	Blustering, cold and cloudy, fish feeding badly.
" 3	" 9½	" 22	" 38	Blustering, cold and cloudy, fish not feeding good.
" 4	" 12½	" 30	" 39	Moderated by noon and clear, fish feeding better.
" 5	" 16	" 34	" 41	Warmer and clear, fish feeding good.
" 6	" 15½	" 30	" 41	Moderate and clear, fish feeding good.
" 7	" 18	" 40	" 42	Warm and clear fish feeding very good.
" 8	" 17	" 30	" 44	Warm and some rain, in spite of rain fish fed good.
" 9	" 24	" 36	" 44	Warm and very fine, fish feeding good.
" 10	" 21½	" 46	" 45	Blustering and cloudy part of the day, fish feeding very good, some rain.
" 11	" 16	" 20	" 43	Blustering and colder, fish feeding good.
" 12	" 10	" 34	" 40	Short of food.
" 13	" 00	" 24	" 40	No food.
" 14	" 13½	" 28	" 39	Blustering and cold, fish feeding fairly well.
" 15	" 15	" 30	" 39	Some warmer and clear, fish feeding better.
" 16	" 14	" 20	" 39	Snowed all the forenoon, clear in the afternoon, fish feeding fairly.
" 17	" 15	" 24	" 40	Some warmer, fish feeding fairly well.
" 18	" 9	" 20	" 40	Snowed and cloudy all day, fish not feeding good.
" 19	" 15½	" 26	" 40	Clear, fish feeding better
" 20	" 17	" 42	" 41	Warmer and fine, fish feeding good.
" 21	" 15½	" 36	" 40	Some colder, fish feeding fairly.
" 22	" 16	" 22	" 41	Warmer and clear, fish would have taken more, did not have it.
" 23	" 18	" 40	" 44	Cloudy and some rain, fish feeding good.
" 24	" 10	" 43	" 44	Warm and clear, short of food.
" 25	" 11	" 40	" 45	Short of food, weather very fine.
" 26	" 21	" 42	" 46	Weather fine, fish feeding good.
" 27	" 19	" 38	" 47	Cloudy and some rain, fish feeding good.
" 28	" 20	" 42	" 45	Weather fine, fish feeding good.
" 29	" 9	" 50	" 45	Short of food, weather fine.
" 30	" 00	" 42	" 44	Out of food, weather fine.
" 31	" 18	" 38	" 45	Weather fine, fish feeding good.
	376½ lbs.			

FRED MATHER.

FRY VS. FINGERLINGS.

By Herschel Whitaker of Michigan.

Much has been said and more has been written in the last two years regarding the desirability of planting fingerling trout as against the planting of fry, as a surer and more effective means of stocking the streams of the country. The idea, like all new ones, has found ready advocates who have taken up the cry, until it has come to be believed that there is real foundation for the claim, and that it is a mistake to pursue further efforts along the line of fry planting. To those who have had experience in fishculture and are familiar with the results of the work done for the past ten or fifteen years, I think the claim of the fingerling advocates does not appeal very strongly, but with the unthinking ones it has met with more favor than it deserves or would have received upon a full and thorough investigation.

In considering this question we cannot fly in the face of past great success as the result of stocking waters with fry. neither can we disregard the fact that if plants are made of fish at a fry age we have attained the maximum of output at a minimum of cost. That the cost of raising fish to the fry age is cheap no one can deny, and that it has been eminently successful is beyond refutation. This being admitted let us recall for a moment past experience and see what has been done and what has resulted from fry plants.

No stronger argument can perhaps be presented on this point than the remarkable success attending the restocking of the shad rivers of the Atlantic Coast, which have been restored from a point of great decay to a condition where the fishing is profitable. This is emphatically the case with some of our salmon rivers, and noticably the Penobscot where the run of the salmon had almost entirely failed. The papers devoted to angling and fishing interests have shown that for the last three or four years, or

perhaps more, the salmon are beginning to return to this river, and the spring accounts of the fishing at Bangor, made daily show that the stocking has been a success beyond all question, fish being taken as high as thirty pounds weight. The salmon and shad being anadramous inhabit, the fry have had to run the gauntlet not only of their natural enemies in the streams which they frequent but of the countless enemies of the ocean where they remain for the greater part of the year. Notwithstanding this condition of things the results speak for themselves.

So much as a brief statement of what has been done in the sea coast fisheries of the country, and now let us consider for a moment the results of inland fry planting. It seems scarcely necessary in a body of this kind that I should call attention to the numerous and almost innumerable inland streams of the New England, Middle and Northern and Northwestern States which have been restored from a decimated to excellently stocked streams.

But let us go a step further. There was a fairer field for the demonstration of success in fry planting than has been afforded in my own state of Michigan, Prior to 1841 the lower peninsular of Michigan was practicably a zoological desert as far as the brook trout was concerned. Fry planting has been going on under the efforts of the Michigan Fish Commission for the last eighteen years, but it cannot be said to have been adequately done in point of numbers until the years following 1880; yet for ten or twelve years fine trout fishing has been had in more than half of the counties of that peninsula, and with the advent of this spring the number of streams opened to public fishing has been largely increased, until it may now be said that Brook trout can be had for the taking in fully two-thirds of the counties. This is in some measure true of the state of Wisconsin.

The Saranac lakes in New York furnish another evidence of the success of fry planting of whitefish under somewhat adverse circumstances, the lake in which they

were introduced being filled with their natural enemies, and yet from a small plant made in this lake about the year 1885 we learn that adult fish have been taken.

All fishculturists who attempt to keep up their stock of parent fish by raising a certain quantity of fry each year are familiar with the great mortality occuring at the period when the young fish has finally absorbed his food sac, and is ready to take the natural food provided by nature. At this time when he "rises" in search of this natural food if he does not find it he is compelled to take the artificial food prepared for him, and the difficulty of adapting his stomach to this food results in a loss which varies somewhat from fifty to seventy-five per cent. If the young trout at this period of his existence were allowed to forage for his natural food this mortality would be greatly reduced. There are streams that are well known in Michigan which have had plants of fry not to exceed five hundred in number which within three years from the time of stocking have shown up well, and to-day without further stocking afford good sport to the angler.

Within the current month there appeared in the Detroit daily paper an interview with a prominent fishculturist who took occasion to say "I believe, and against great opposition have always maintained, that 100,000 yearlings planted were more likely to live and thrive than 5,000,000 fry." Making due allowance for the enthusiasm of the interviewed party and for the natural predisposition of man to defend his pet theories, let us see where these figures would leave us.

We will start with 5,000,000 fry planted, and we will say that twenty-five per cent. perished the first year, ten per cent. the second year, and five per cent. the third year. At the end of the second year after deducting the twenty-five per cent. for loss, and estimating the number thus left to be composed of one-third females, which would cast on an average 250 eggs apiece, there would be added to the stock 281,250,000. Estimating that there will be a

loss of seventy-five per cent. of this number we have left 70,312,500. At the end of the third year we would have 1,068.750 spawning females casting on an average 450 eggs each amounting to 480,937,500. Deducting from this amount seventy-five per cent. for loss, and we have left 120,234,375. These added to the original plant, after having deducted therefrom for loss on the original plant twenty-five, ten and five per cent. for the three years, and we have left as the result of a 5,000,000 plant 193,753,125.

Now let us take 100,000 yearling trout: At the end of the first year after planting we deduct ten per cent. for the mortality in the adult fish which leaves us 90,000. Of this number one-third being females, we would have 30,000 spawning fish which would cast on an average 250 eggs apiece. This would give us 7,500,000 and deducting seventy-five per cent. for mortality we have left 1,875,000. At the end of the second year after planting after having deducted five per cent. loss for adult fish, 85,500. One-third of these being spawners, will cast 450 eggs, each amounting to 12,825,000. Deduct from this amount seventy-five per cent. for mortality and we have left 3,206,250. At the end of the third year after having deducted five per cent. for loss we have left 81,225 fish. One-third of this number being females will cast on an average 900 eggs to each fish amounting to 24,367,500. From this amount deduct seventy-five per cent. for loss, leaving 6,091.875.

At the end of the third year we must also take into consideration the fry hatched from the fish hatched at the end of the first year which will have arrived at their first spawning age. This number will amount to 1,875,000. From this amount deduct twenty-five per cent. for mortality and we have 1,406,250. One-third of these being females leaves 468.750 spawners which will cast 250 eggs apiece amounting to 117,187,500. Deducting from this quantity a loss of seventy-five per cent. and we have left

29,296,875. The above amounts added together make the total result of the planting of 100,000 yearling trout at the end of a three-year period amount to 40,551,225, as against 193,753,125 as the result of the fry planting of 5,000,000.

Considering the results, therefore, of fry planting from which practically all the results we have are due, we must assume that it has been eminently successful, and when we consider the cheapness with which this work is done it would seem that the ample success of fry planting is simply incontestable.

The President asked for discussion, and

MR. FAIRBANKS said: It has occurred to me on hearing these papers that there is an opportunity or chance to harmonize the views of these people, according to the location and the character of the streams of the country in which they are located. If there is anything I can do to harmonize Mr. Clark and Mr. Mather, I will do so. In the first place, consider the question of feeding young fry on their natural food in natural ponds. That of course takes into account the matter of the cost of constructing those ponds. If the grower of the young fish is so situated, if his springs are such that he can construct these natural ponds cheaply, if he can make thirty or forty of these natural ponds of a hundred feet in diameter in which he can plant the weeds and the moss and the plants that the shrimp grow in naturally, he can feed his young trout until they are yearlings at a very small cost; the whole cost is in the original construction of the ponds. Mine are very cheaply constructed, a very trifling sum. If they are so situated that those natural ponds can be constructed and the natural food of the fry can be put in there, you can turn your fry in and raise them at a very small cost. Under such circumstances I have no doubt the yearling trout is the best one to transplant. But if he must be fed and it cannot be done cheaply, or

if it is very expensive, as in the case of Mr. Mather, then I should plant the fry by all means.

There is another important consideration which, to my notion, has more to do with it than the other. That is the character of the stream in which you plant your fish. The success in Wisconsin has been very great, as has been stated in the paper which was read. I have been familiar with that. I got the first bill passed which established a commission in the State of Wisconsin, some fifteen or sixteen years ago. The streams in Wisconsin are much larger and deeper and better streams to plant fry in than are the streams in New York and Pennsylvania or any of the New England States, which are small, babbling, shallow brooks, abounding with all sorts of little fish, enemies of the fry. But you put the fry in these Wisconsin streams or in the Michigan streams and the water is deeper and they have a great deal better chance; they do not have nearly as many enemies as they do in the streams of New York, Pennsylvania and New England. And in those streams I am inclined to think that a yearling trout is a better fish to put in than the fry. Of course you have got to be governed in your location by the expense; that is another element. Where your yearling trout costs ten cents, as in the case of Mr. Mather, there is no question about it, the fry is the cheapest, and you will get better results from it. But if you can feed the fry on natural food and it does not cost you anything up to a yearling, then the yearling is the better fish to plant. My yearlings do not cost me anything. I give them absolutely no attention whatever, in these natural ponds that I speak of, and where you can construct those natural ponds—and there are very few places I think where you cannot—I think even where Mr. Mather is he can construct a dozen or so.

MR. WHITAKER—Are those private ponds or feed pond for other streams?

MR. FAIRBANKS—No, they are private ponds. But I

have no doubt where you have hatcheries, where the land is right, the formation is right, and you have water enough to construct your natural ponds at moderate expense, then you can raise your fry up to a yearling at a very trifling expense, and in that case yearling planting is the best. But you cannot lay down inflexible rules, because it depends so much upon location and expense and other causes.

MR. CLARK—I do not wish to occupy the time of the members on this very much discussed question, because there has been so many things brought up here it seems to me, only to be answered by another paper another year. As to the personal attacks upon me, I have nothing to say, any further than this, the quotation as it has been remarked here by one paper—which is a personal attack, for it uses my name—I made a statement that I believe 100,000 yearlings were better to stock streams that 5,000,000 fry. And I still believe it. I can show quotations from eminent men—more so than myself—I think if you will look at the reports, our late Professor Baird made a more rash statement than that. We have already had one paper read here to-day by some gentleman from England, I think; the statement in it is broader than mine, so that my statement is not the worst that ever was. Here are a few figures that Mr. Mather gives us in regard to the cost: He makes out that fry, or yearlings, rather, cost ten cents a piece. I make out that they cost less than a cent apiece. Perhaps from my paper you did not just exactly understand how I arrived at that. I took two years. There was no guesswork about the cost of my business, that I know. I did it on the same principle that your bank examiner of the State calls for a report, and takes every book. You simply have got to give him a report of what it is. The figures for food of those two years were taken from the books and accounts of the U. S. Fish Commission, and the books are open for inspection; that you will know.

The cost for food was taken. I did not commence two years ago to keep track of this, but I simply took the beef liver bill; and of course you know, and every other fishculturist knows, that for the first two or three or four months, at least a half of that is wasted. I did not, as brother Mather says, weigh this food; I simply took the bills; that is the way I arrived at what it cost. Then the amount of labor was as I have given you. If my men were called off, down went the pencil, so much time on the fry, and it was the actual time in regard to it.

There is one point in regard to yearlings that I wish to state as near as I can. It is possible that some of the U. S. Commission men can help bear me out in this. Two years ago last August, I think it was, there were 80,000 yearlings—they were well-grown fish—were taken to the Yellowstone Park by the U. S. Fish Commission. As I understand to-day from very good authority, the Yellowstone Park streams and lakes are well stocked with trout; and they did not have the trout there before. It is well stocked with good fish.

MR. PAGE—I think they have succeeded so well that they have very young fish there also.

MR. CLARK—Good results from yearling planting. On the basis of what those fish cost me, there would be probably $800. and you count the expense of getting them on the ground, and the men's time that distributed them, and all that, probably would be $400. more, something like that, I can't give you accurate figures. Mr. Mather says a hundred fry can be raised for less money than it costs to raise one-year old trout. I have not figured that out; it would seem as though that is not right, but I have not figured it out.

MR. BOWMAN—There are some facts that these gentlemen can all agree upon. It certainly is a great benefit to plant either fry or yearlings. I think it is a conceded fact by everybody that yearlings are better than fry. It is a simple question of which can be produced

the cheapest and which will produce the greatest result for the least money.

This question of food is a particularly interesting question. Caledonia has been alluded to and the Spring Creek at Caledonia. And I think there is no stream on the face of the earth that produces the amount of natural food for trout that that stream does. It has a great variety of plants. If you pick up a handful growing in any part of the creek, it will be alive in your hand. Where you have a stream of that kind, and where these mosses and those plants can be set in the stream which will produce that amount of food, of course you can rear a limited number of trout to a year old at a very little expense. We have raised for years at Caledonia—for the last five or six years—anywhere from five to ten to fifty thousand yearling trout. We have not adopted the plan of the gentleman from Wisconsin. But we have raised in ponds four feet wide by twelve feet long a stream of water running through, feed them upon liver, chop it and put it throngh sieves until it is reduced to a pulp; and to-day at the ponds at Caledonia we have ten or fifteen thousand yearling trout, we have pursued a policy of distributing both, although the greater amount have been distributed as fry. What we want is best results for the smallest amount of money. That ought to be the object. Produce the greatest results both in trout and food for the smallest amount of money. That has been our aim.

Now the results obtained. One result for instance: shad were never known upon the Pacific coast until that coast was stocked by the Commissioners of the State of New York; and I understand that shad to-day are abundant upon that coast, and sell, I understand, from ten to fifteen cents apiece. That stocking was done with fry, fry were taken from our coast to the Pacific coast by Seth Green, under the direction of the Fish Commission of this State, and were turned loose on that coast where

there were no shad before. The result is you have abundance all over that country.

As has been alluded to, the Hudson River has been stocked with fry, and the Connecticut River has been stocked with fry. After a certain length of time the Connecticut River ceased to be stocked and the Hudson River continued to be stocked, and the result has been that we have found fine fishing every year in the Hudson River, while the shad have almost disappeared in the Connecticut River, and yet the two rivers are only a few miles apart. This has been the effect of stocking with fry. Take the Chatauqua Lake, in which there was never any bull head until they were put in by the New York Commission. They are a very much abused fish, for in good water it is an admirable fish. To-day anyone can go out with a hook and line, into Lake Chatauqua and can take a good basket in a very short period. That was stocked by putting in the adult fish. Of course the bull head and the black bass are different from almost any other fish; they make their own spawning beds and take care of them during the process of incubation and they protect their young until they are large enough to protect themselves. Hence the New York Fish Commission have always stocked different lakes and different streams in this State by putting in the adult fish. Where you have a fish of that kind that will take care of its young, that will fight everything away from the spawn, the sucker and everything that comes to eat it up, and will take care of it until the fry take care of themselves, there is no doubt that putting in the larger fish is a decided advantage. With the trout they do differently. Trout makes its spawning bed with its tail, deposits its eggs upon the sand, the male comes along and deposits the milk and they go away and leave it. The young fry is hatched by the water going over it. As they come out, nature has provided a little sac upon which it feeds until it is old enough to search for its own food.

Air and water are usually furnished without price, but the great struggle of the animal world is to get food, and it feeds upon anything it can come to; if driven, upon its own kind even. After this sac is absorbed, this small fish immediately turns its attention to taking care of itself. The small fish or fry instinctively seek at once the upper channels—you never see fry going down stream. I can go right into Caledonia and I will find little trout wiggling up stream. I think they instinctively go up stream to get food and get away from their enemies. This is simply a question of opinion, and I think gentlemen should express their opinions fairly. I am not a believer in the fact that so many of these fry are consumed by their enemies as a great many men seem to say. Of course there must be great mortality; they have a great many enemies. So have the larger fish: you have the snake, the kingfisher and a variety of enemies, and more or less fish will be consumed. But the fact is patent, that the streams of Michigan and Wisconsin and the Adirondack region of the State of New York, have been stocked by the distribution of fry. Now, my own judgment and my own belief is, that that is the cheapest and the best way to produce the best results. We hatched at Caledonia from four to six millions of fry. To raise those to yearlings, you cannot do it on my friend's plan from Wisconsin. Perhaps there is a water that you can put in twenty or thirty pounds at the most. If I had a pond of my own and was pursuing it for my own benefit, I would undoubtedly pursue the same course as my friend; but when you pursue business on a wholesale scale, you have got to follow a different plan from where you plant two hundred thousand for your own use. I can raise any amount at Caledonia, but when you come to raise four or five millions for distribution, you have got to have something to supply the demand. And I think that is where this question turns. If you are going to raise a large number, five, six, or

eight, or ten millions to distribute over a State, I think it would be impossible to raise them to yearlings. If you want to raise a limited number, you can do it in almost any hatchery in this State. I think it is desirable. We have pursued the plan of raising every year three or four or five hundred thousand, and we raise them in these ponds. Many of you have seen them. We require a little different applications from those which many of the gentlemen here have spoken of. We ask the applicant to tell us the depth of the water, the temperature of the water, whether hard or soft, and a general description of the stream; and if we find that fifty or a hundred yearlings will start that stream better than the fry, we send the yearlings. We have done that in several instances, although the great distribution has been made by the distribution of fry to different places.

It strikes me as though the judgment of every person here is to do the greatest good to the greatest number. am glad to see this discussion; progress comes out of it. If any man can convince me, show me we can do better by planting yearlings than fry, I would stop as a commissioner and advocate the policy of never distributing another fry, but all yearlings. But I believe the best thing to do is for each hatchery to raise a certain amount of yearlings and distribute fry, put them up in the upper part of the small streams where they can take care of themselves and where they can find other food after the sac is gone. They can be transported readily up into the upper streams where they can hide. I think you will find the best results in that. I think experience has shown that the streams of a country can be stocked quicker and cheaper in that way than they can in any other. (Great applause.)

MR. MAY—I will read a couple of telegrams addressed respectively to Dr. Herschel, one from Mr. Blackford, and the other from Mr. Collins, Chief of the Department of Fish and Fisheries.

Mr. CLARK—There is one little point here. Some of the members here do not know me as well as Mr. Mather does. I do not wish it to be understood that I advocate nothing but planting yearlings. Not for a moment. It would be utterly impossible to raise them. But I mean to do as the United States Fish Commission does, last year at their carp ponds in raising shad put in there, raise what you can. White fish the same way.

MR. BOWMAN—Have you ever raised a shad from young?

MR. CLARK—They have shad that are fourteen months old as I saw them, nice, clean, healthy shad, in salt water. The shad the gentlemen saw there last year, they were two inches long. Now, with shad and white fish, what I advocate is having places of that kind to keep them and then let them go out in the fall as two, or three, or four-inch fish, but not undertake to raise them all.

MR. FORD—I have a statement to make: I have never believed that the young trout fry were always subject to danger from so many enemies, as was popularly supposed. I asked our superintendent to make a plant in a small stream that runs through our grounds at Allentown. This is what he says: "I planted the fry at the age of six weeks or about the middle of February and visited the stream once or twice a week until April 1st. I always found the fry just where they were planted. They appeared to be doing well and growing faster than those in the hatching house planted in March or April." They all appeared to do well. I certainly do consider it the best and most economical way to plant a stream, put fry out. They have been well fed. The fry are large and strong, and able to take care of themselves. Now, I will say that the State of Pennsylvania has always put out her fry at the age of two or three months. This year we have put out over three millions young fry. We could have put out six millions; we had applications for that many, but we didn't have the fry. Again

in the River Delaware, where the U. S. Fish Commission first planted fry, they were dumped in at high water. But of late years they have been putting them up in the headwaters of the stream where the young fry naturally go. The result has been that there has been a great increase. The value of that shad taken in the Delaware River in 1881 amounted to $80,000, and in 1890 and 1891 between $500,000 and $600,000, showing a great increase and very satisfactory. I am no advocate of keeping young shad until they are large; I think putting them in ponds deprives them of their natural food.

Mr. Rogers of Nova Scotia—I have been intensely interested in the various papers to which I have listened to-day, particularly on the subject of fry versus fingerlings; and on fish food. Any knowledge I possess on the subject is entirely practical. I live in a fish country, and we have been for the last fifteen or sixteen years planting salmon. We have been conducting under the government fishculture on a pretty large scale. In Nova Scotia where I reside, many millions of salmon fry have been planted, and the results up to the present time have been very small. I am decidedly in favor of fishculture. Its possibilities are practically unlimited; there is no question about that.

I want to relate two or three facts in relation to fish after the fry planting, which will be of importance, I think. I communicated some of them some years ago to Professor Goode of Washington. He was here this morning.

I spent my childhood, my boyhood and manhood, close to a small river running into the country about thirty miles. When I was a boy we could buy a thirty-pound salmon for twenty-five cents; the river was literally crowded with fish. In process of time, across the mouth of the river, it was a common thing to see three or four hundred salmon dead, as a result of slaughter by

butchers. That ended it in a few years. Then not a fish was caught or seen in the river until a few years ago. We planted salmon fry at the very headwaters of the river. We planted them for the reason that the railroad crossed the head of the river and brought up the young fry from the hatchery; and that was their natural place; their instincts led them there to hatch their young, which takes about five months. They plow furrows in the gravel and cover them over, and the water filters slowly through the gravel, and produces the continuous slow change, and the current carries away the autumn leaves so that the eggs will not smother. They also go there to get away from the abundance of the natural enemies of their young. This river I refer to, is now full of salmon. It is the only river in Nova Scotia that I know of, and I am familiar with all the practical results of planting fry, and I attribute the success to the reason that the fry are planted where they belong. In the other rivers, they are mostly all planted down at the lower portions of the rivers. These facts cannot be disputed. I communicated them to Professor Goode.

The other fact is just this: We are in the habit of catching five or six hundred salmon in the early weeks in June and inclosing them in an inclosure and keeping them until October. We have tried to induce them to take food, but they won't touch any sort of solid food. They are there for five months. In October they have rather gained in weight than lost. What did they feed on? They took no solid food. May it not be that they get their food out of the water? This would be for scientists to determine. I have thought that the water comes down over the watersheds in the spring months, richly freighted with that vegetable property which the bird gets in the bud and the wild animal gets in the bark and you and I get in the grain. This is their sustenance, they get it in liquid form. It is certain they eat nothing. May it not be possible that the fry feed on the same?

MR. FAIRBANKS—These salmon are weighed before spawning when they come in in June, and then in October you weigh them just before spawning, the spawn having been growing all the while, growing on the food which they got out of the ocean and the water, etc. It is the increased weight of the spawn that probably makes them weigh more. After they have spawned they would weigh a good deal less.

MR. BINCOTT—I am very much pleased to see how cheap fish breeding has become; I mean to say that for the first time in my life. I have been in this business off and on for a long while. I now find you can raise trout and raise fish for nothing! And it is a miracle to me that the thing should come down to that basis. And if we can put out yearlings at a few cents a pound, I think we ought to go to work and do it. I was formerly in favor of fry; now I am in favor of yearlings by all means. For I find they can be brought up for nothing. One gentleman says nothing; one says eight cents; another says four and five cents; another says under eleven. That is the highest price. So I am decidedly in favor of yearlings. I think it would pay the United States to hire those gentlemen to show how it can be done, and buy our fish from them and stock our rivers. It is the cheapest thing I know of. (Applause.)

DR. HUDSON—I want to say this single word to correct a wrong impression of the gentleman who represents the State of New York, Mr. Bowman. He stated in his remarks that while the Hudson River was being stocked annually with shad fry, that they had ceased doing the same on the Connecticut. I have no means of knowing where that impression arose. I know it does exist, but it is not correct. During all these years that the shad has been decreasing in the Connecticut River, the stocking has been going on precisely the same as formerly, and in very large numbers. If you ask me why the shad are now decreasing where they formerly

were increasing, it is a very difficult question to answer indeed. There is no doubt about the fact that the Connecticut River being a smaller river than the Potomac, or the Delaware, or the Hudson, that it is very possible that the methods of fishing adopted at the mouth of that river may have had very much to do with the decrease of the fish. Gentlemen who are not familiar with the Connecticut River may not be aware that we have a system there which, so far as I know, cannot be adopted in any other river in the country; that is, I mean to such a deleterious effect upon the shad. The shad coming into the Connecticut River, as they approach the river come from the West generally. Whether they come from Montauk Point or through the bay from the North River and the East River, of course no one knows; but they do strike the coast of Connecticut somewhere along for a distance of ten or fifteen miles from the mouth of the Connecticut River. It should be borne in mind, that the water from the mouth of the Connecticut River does not go straight into the Sound, but makes a bend around to the right, so that nearly for ten miles around from the mouth of the Connecticut River water can be dipped from the surface of the Sound fit for drinking purposes. As the shad reaches this fresh water to go into the Connecticut River, of course they are directed towards the mouth of the river and follow along in that direction. Now I am going to allude to the effect of pounds on the Connecticut River: Those were established in 1849 along the mouth of the Connecticut River for ten miles, every few rods during that whole distance; those pounds were erected in the run at ten, thirty and forty rods, sometimes two and three miles out into the Sound, each year further and further. They were so arranged that every fish coming along from the Sound seeking the mouth of the Connecticut River had to run the gauntlet of that entire lot of pounds, fifteen, twenty, thirty of them running that distance. Those

pounds fish twenty-four hours in the day and seven days in the week. And how under the circumstances any shad ever succeeded in getting into the Connecticut River, was always a mystery to me, notwithstanding the fact that they did come in in considerable numbers. Just as soon as they have passed that gauntlet, the moment they enter the mouth of the river, they find from eighty to a hundred gill nets sweeping down into the river into the Sound, taking what shad were left from the pound. Those few shad that safely go above these gill nets, as soon as they reach Essex, which is about the upper station of the gill net, then every single station on the river from there to Holyoke where it was possible to run a sweep net a sweep net was put; and these were so arranged as to go across the river and one follow the other as fast as possible. That fishing was continued in the Connecticut River for years until finally shad began to decrease very rapidly. In 1870 or thereabouts, after the shad hatching first began in the Connecticut, we increased the shad so rapidly, and there was such immense quantities of them that the fishermen begged us to desist, saying there is no use hatching shad you cannot sell.

But the work was continued, the commissioners believing that the proper work of the commission was to make shad cheap for the masses. As I said before, this fishing had gone on in such a way. But whether that is the cause of the decrease of the shad, I don't know. I have stated this to correct Mr. Bowman's idea. The commissioners have continued all through this time putting shad into the Connecticut in enormous numbers up to within a year or two, and the last year or two it has been continued but not to such an extent. But in the meantime the shad have come down from some four or five hundred thousand a year to about twenty thousand. For this year, as far as I recollect, the number is about thirteen thousand, as I have heard only recently.

MR. FAIRBANKS—They all increase very largely after the putting in first begins.

DR. HUDSON—Yes; though they have been putting them in very large numbers of recent years; some fifteen, twenty, thirty or forty millions every year up to about two years ago.

MR. BOWMAN—Were those brought from other places?

MR. HUDSON—Yes. The work has been going on constantly. There is another reason which has been alleged. The fishermen allege this as one reason why the shad do not come into the Connecticut, namely, the breakwater which has been built near the mouth of that river by the U. S. Government for the purpose of increasing the depth of the outflow over the bar. They claimed that the effect of that is to send the water directly into the Sound instead of to the West as formerly; therefore they think that may have thrown the shad into some other river, from the fact that further to the West towards New Haven some of the men take a great deal more than they do.

MR. BOWMAN—Can it not be that there is contamination in the water.

DR. HUDSON—As I was saying before, the Connecticut being a small river it may be more easily affected by contamination.

MR. JAMES—Of course there is a question whether any contamination has been noticed along the river.

DR. HUDSON—There never has been in regards to shad, but as to small fish there has been; carp and dace and such things, but not with the shad.

MR. FORD—The proof of Dr. Hudson's remarks has been borne out by our experience in the Susquehanna and the Delaware. In the fourteen miles of the Susquehanna within the State of Maryland there are hundreds of fishers that catch the young shad as they go down to the sea, and with the pound nets in the mouth of the river, there has been a constant and continual decrease in

the catch of shad in the Susquehanna. In the Delaware in our State, in Pennsylvania, we have laws that everybody fishing with nets after the close of the shad season in the upper streams, that protect the young fry from the fine meshed nets, which are so destructive on the other rivers.

MR. MATHER—I want to say a few more words. I had concluded not to say a word more on the question of fry and yearlings, but I must add this: I have seen it stated that in some of the streams in the Yellowstone Park or West, several attempts were made to plant with fry, which failed, and other attempts made with yearlings succeeded. Now, the question naturally arises, suppose these yearlings do succeed and spawn there, what is to become of their fry when they are hatched? They are the same kind of fry and of the same age we would plant. And it strikes me that if that is the case, if fry cannot live in those streams, and nothing but yearlings can, you have got to put in yearlings there every year or else there won't be any fish left. And as we have said something upon the cost of the fish here, without knowing what their views are, I would ask Mr. Gilbert to say what he thinks a yearling trout will cost to raise, and I will ask Mr. Hoxie to give the same opinion.

MR. CLARK—Did you make a statement that fry could not live in the streams?

MR. MATHER—I said it had been said.

MR. CLARK—How can I answer the question?

MR. MATHER—The idea is this: If you plant fry in a stream and they cannot live, and if you plant yearlings and they do live, how are you going to stock that stream if fry cannot live in it?

MR. CLARK—Will Mr. Mather point out where I am quoted as saying that I would do anything of that kind?

MR. MATHER—I do not say you said it; I say it has been said.

MR. CLARK—If I found that fry did not live in the

streams, I would not plant yearlings. If I found that the fry were eaten up by something else, I would try yearlings to see if they would live.

MR. FAIRBANKS—I would suggest that yearlings might be put into a place in a stream where food did not exist, and when they came to spawn their natural instinct would take them to the place in the stream where food existed. Just like trout go to spawn on the reefs in the great lakes because their food is there for the young. And the yearlings would naturally hunt up in the stream a place where there is some food.

MR. MATHER—About the cost of raising trout I should like to hear.

MR. GILBERT—The cost of my feed last year was about $400, and with that amount of food I raised about 30,000 yearlings. I have got now that number, and we have sold since the first day of April, 5,730 pounds of trout to the time I left home yesterday morning. Those have been raised from yearlings to two years old, large enough for the market, and also the 30,000 year old trout, all for the sum of $400 for the food for the whole year. I cannot say what part contributed to the young fry or to the yearlings or the year old fish up to two years; I do not keep any separate accounts. That does not include the cost of labor, but merely food.

MR. MATHER—What do you expect to sell your yearlings at?

MR. GILBERT—Well, we want $100 a 1,000. I would sooner sell fry for $4 a 1,000 than sell yearlings for $100 a 1,000. When you get trout a year old, my loss is not probably five per cent.; I do not know that it is three per cent. from year old to two years old. The great loss is up to four months. Although I do not know that up to the present time——. By the way, we never feed in the hatching boxes.

SALE OF ARTIFICIALLY REARED TROUT.

By W. L. Gilbert.

I have always been greatly interested in the fish and game interests of the country, and also in the passage and enforcement of all reasonable laws for the protection of the same.

I presume my father did more than any other man in Plymouth, and at his own expense, in stocking the public waters of that town with black bass and white perch. I have on several occasions restocked the only public trout stream in Plymouth with trout fry whenever I had a surplus after stocking my own ponds.

As only a small portion of the people are interested in the fish and game laws, it is always well in framing them to guard against the possible danger of having them so arbitrary as to interfere with the private rights of the people or with their industrial pursuits. We had an example of this nature in Massachusetts. Under the law the Fish Commissioners had power to lease the fishing rights in any great pond of over twenty acres to private parties, and they did so with a large number, thus taking away from the people at large the right to fish in any leased pond, under a penalty of $20 to $50 for every offense. The people stood it for a few years, and in 1884 they appeared at the State House in force and demanded and obtained the repeal of the law, and now the commissioners have not the power to lease any pond in the State.

The policy of Massachusetts, and also of other States, has been to encourage the cultivation of trout and other useful fishes as a food product, and it was for this purpose that the several States and also the United States organized the Fish Commissions, and Massachusetts passed the law of 1869, the title of which is "An act to encourage the cultivation of useful fishes," by which act

the people, for this purpose, surrendered to private parties, being riparian owners, all their fishing rights in every pond of less area than twenty acres, also in every unnavigable stream in the State. It also made fishes artificially cultivated or maintained the absolute property of the person cultivating or maintaining them. It also made it a penalty of $20 to $50 to fish in any waters in the State in which fishes are lawfully artificially cultivated or maintained.

The commissioners called the attention of the people to this law in their report for the year ending January 1, 1870, in the following words: "The need of such a law as this is the same as the need of a law to protect any industry. While on the one hand we recognize the fact that a supply of good fresh-water fishes, among which we class the salmon, shad, trout, black bass and smelt, are essential as food for our people, we are still compelled to admit that the supply is constantly diminishing, and that several of these fishes are in many localities exterminated. For this deplorable state of things there was but one remedy, and that was to make fishes under certain conditions property, and thus give the same stimulus to the cultivation of fish that is given to the raising of any other live stock. Under the knowledge we now have such cultivation is as easy as that of poultry."

The successful cultivation of trout is no longer a matter of doubt. It has passed through the experimental stages and now stands out as destined to become one of the great industries of the people, and it will if the several States will only realize the importance of encouraging the industry by repealing or modifying the restrictive laws in relation to the sale of artificially reared trout. Some of the States have already done this. Connecticut, Rhode Island and Maryland have modified their laws in relation to the sale of trout artificially raised, and a bill to that effect has already passed the Massachusetts Senate, and is now pending in the House of Representa-

tives, and we trust New York and other States will follow suit in the near future. Our trout are all artificially reared from the egg, in artificially made ponds and on artificial food which we buy, and we pay a tax not only on our plant but also on our trout as stock in trade, and the law declares them to be our absolute property.

Under these conditions we feel that we are entitled to the same property rights in trout at all seasons of the year that every class of property that is useful to man as a food product has, namely, the right to sell it at any and at all times when it is desirable to do so, and that our customers and ourselves shall be the judge of when that time is and not the State. Remove the restrictions from the sale of cultivated trout from January 15 to April 1, and people now in the business will enlarge their establishments to their utmost extent to meet the largely increased demand, and others will be induced to enter into the industry to such an extent that ten years hence fifty pounds will be raised annually where one is now, thus giving employment and wealth to the people engaged in the industry, taxation to the towns and State, and the advantage of having this additional amount of food fishes added to the food product of the country during the latter part of the winter, when nearly every kind of fish is scarce and often in poor condition, while cultivated trout are in fine order. It is an old adage that he who makes two blades of grass grow where one grew before is a public benefactor, and it must be admitted that he who makes ten thousand to twenty thousand pounds of trout grow annually where none grew before is also a public benefactor, and if restrictions against the sale are removed or modified, large tracts of now waste land and water will become valuable for the cultivation of trout, and the expectations of Dr. Garlick, Dr. Ackley, Ainsworth, Seth Green, Livingston Stone, Theodore Lyman and other early disciples of fishculture will be realized, much valuable property created annually, many persons bene-

fitted, and no one in the least injured. I trust this society will give this subject careful consideration, and that the laws of the several States will soon be changed so as to give full justice to fishculturists.

STATE CONTROL OF STATE FISHERIES.

By Hoyt Post of Michigan.

At the last meeting of this society, just at the close of the session, there was hastily adopted a resolution, prefaced by four whereases, upon a subject matter which has since attracted considerable attention in certain quarters.

This resolution related to petitioning Congress to assume the work of protection and propagation of fish in the waters of the great lakes, and the whereases suggested taking this work out of the hands of the several States which are now conducting it, it is said, "with slight probability of ever arriving at a harmony of action," and placing it in the control of the Federal Government, which, it is stated, could, "with its great scientific, mechanical and financial resources, its power to make agreements with Canada, and its ability to enact and enforce regulations," "undertake this work with far greater results" than have heretofore been attained. This resolution was a source of surprise to several of the State Commissions, and especially to that of Michigan, which took prompt action upon it.

In October, 1891, a meeting of the Fish Commissioners of New York, Pennsylvania and Ontario, with representatives of the United States Commission, and some others especially interested in the subject, was held at Fifth Avenue Hotel in the City of New York, the object of which was stated to be the "protection, pre-

servation and propagation of food fish in the great lakes."

This meeting appointed a special committee which met at the Chamber of Commerce in Rochester, New York, on November 10th, 1891, at which meeting a series of resolutions was adopted, which were afterwards reported to the final meeting at Hamilton, Ontario, December 8th, 1891, and there finally adopted. The portion of the resolutions which pertain to the matter under consideration in this article is as follows, viz.:

"*Resolved*, That this body regards with disfavor any movement looking towards the turning over to the United States Government the work of the State Commissions in propagating and planting commercial fish in the great lakes;

"That the jurisdiction over the State Fisheries belongs naturally to the adjoining States, whose interest in their success is paramount to that of the United States as a whole; and

"That there is an abundant field for the concurrent action of the bordering States and of the General Government, and anything which would detract from the State's interest in this matter will be detrimental to the end aimed at, of restocking the waters of the great lakes;

"And we recommend a course which will encourage and stimulate greater interest and larger expenditures in this great work by the several bordering States, and at the same time increased interest in the subject by the United States Fish Commission;

"*Resolved*, Further, that this body earnestly approves of the action of Congress in making an appropriation for the establishment of a hatching station on or near the St. Lawrence River for the propagation of white fish and other commercial fish; and of the purpose of the United States Fish Commissioner to carry out the provisions of that appropriation; and we see nothing in this movement

that can in any degree interfere with the jurisdiction of the States in the premises, or to affect in any way unfavorably the work of the States in the protection, multiplication and distribution of valuable food fishes."

Afterwards the same subject was again brought prominently into view by the introduction in Congress at its present session of the Lapham Bill, so called (H. R. 5030), entitled "A Bill to regulate the Fisheries and for other purposes." This bill related on its face to the taking of menhaden and mackerel with purse scines along the sea coasts and shores of the United States and adjacent islands and in the bays, harbors and estuaries thereof, but it contained an insinuating reference to the great lakes. Its evident aim was to extend the jurisdiction of the Federal Government over fisheries in waters which are within the exclusive jurisdiction of the States. This bill received such energetic opposition from the States of Maine and Massachusetts, aided by the Board of Fish Commissioners of Michigan and other States, that the Committee on Merchant Marine and Fisheries, to whom it had been referred, decided by a vote of seven to six that it was unconstitutional.

Thereupon the promoters of said bill caused a new bill to be introduced which was known as H. R. 7553 and which was identical in principle with the former one. This bill was afterwards unanimously decided to be unconstitutional.

The plan of interesting Congress and the Federal Government in the matter of Federal control of the protection of the commercial fisheries, has attracted considerable attention at various times for several years. From a superficial survey of the subject it seems to those not thoroughly informed, very desirable because of its tendency towards uniform rules and laws governing all the fisheries. Consequently the matter has been often considered, and while at first blush it appears very promising yet the conclusion uniformly reached after careful

inquiry is that it is impracticable because Congress has no jurisdiction under the Constitution over the fisheries in waters which are within the boundaries of the States. A thoughtful consideration of the whole subject, however, convinces most persons that it is also undesirable as well as unconstitutional.

October 17th and 18th, 1883, an interstate convention of fish commissioners was held at Detroit, and at the request of the Michigan Board, Otto Kirchner, who was then Attorney General of the State, examined the authorities and announced to the convention his conclusion that it was not within the powers of the Federal Government to assume control of the fisheries in waters within the State boundaries.

Within the present month John Z. Rogers publishes over his own signature in *Harper's Weekly* of May 14th, 1892, an article in which he forcibly depicts the rapid decrease in the catch of codfish, mackerel and lobsters within the past ten years, and shows that the depletion caused by the destructive methods of fishing has resulted in the ruination of the business, and concludes, as so many others have, that the remedy lies with Congress passing laws for the protection of the fisheries.

In view of the precedents upon the subject and the repeated decisions of the courts that Congress has no authority over the matter, it is surprising that people of intelligence should so persistently fall into this error. The right of the State over the fisheries in waters within its borders has been the subject of frequent decisions of the courts of this country, and those decisions have been uniform and without conflict or variation in favor of the exclusive jurisdiction of the State authorities. These decisions are not confined to the State tribunals, but the most potent and forcible of them were enunciated by the Supreme Court of the United States. This unbroken line of decisions commences as early as 1823, with the case of *Corfield* v. *Coryell*, 4 Wash. C. C., 371, and

comes down to the recent case of *Manchester* v. *Massachusetts*, 139 U. S., 258, and embraces elaborate and exhaustive opinions of such eminent jurists as Washington, Story, Marshall, Curtis, Waite, Bradley and Shaw.

The right of the State to control its own fisheries is sustained by the courts as a property right, and as an incident to the ownership of the soil beneath the waters, which has never been ceded or delegated to the United States, and it is held that the State may exclude citizens of other States from using said fisheries and may regulate their use at its direction.

It has been sought again and again to uphold the right of Federal supervision of the fisheries in navigable waters under the grant of power to regulate commerce; but this has been uniformly and repeatedly overruled by the courts. The possession of a United States "fishing license" has been set up as a defense for the violation of State regulations; but it has never been sustained. Legislation by Congress has been urged on the ground that citizens of each State should have equal rights with the citizens of the State in which the waters were, of fishing for floating fish in any navigable waters, but the power of Congress over the matter has been uniformly questioned and ultimately denied. Such a bill was introduced at the first session of the Forty-ninth Congress, and was numbered H. R. 4690. It was referred to the Committee on Judiciary and was reported adversely. The report was drawn by that able constitutional lawyer, J. Randolph Tucker of Virginia. The conclusion of that report is, "that the navigable waters within each State belong to it, subject to the paramount right of navigation, for the benefit of its own people, and it has the right to secure the exclusive right of fishing in them to its own citizens by virtue of their common property in said waters, and that the citizens of other States have no constitutional right, nor can Congress confer any, to participate in fishing in them." This right of the State

is treated as a property right and not a mere privilege or benefit of citizenship.

It is worse than useless then to look to Congress or to invoke the authority of the Federal Government, to protect or control or to interfere in any way with the regulation of the fisheries within the States. It has no power, no authority, over them, and cannot possibly acquire any short of an amendment to the Constitution, which could never be obtained. It is a State matter, and the State alone must be looked to for its proper administration. The sooner this becomes generally known and recognized the sooner will people cease chasing this *ignis fatuus* and direct their undivided attention to the proper authorities to correct the evils complained of, and by placing the duty and responsibility where it naturally and of right belongs, will more surely accomplish the desired results.

Federal control of the commercial fisheries is not only unconstitutional and therefore impossible, and incapable of enforcement; but it is eminently undesirable and unnecessary.

To properly frame the laws necessary for the regulation of fisheries and the protection of the fish from indiscriminate and exhaustive slaughter, requires intimate local knowledge of the innumerable differences of temperature, climate, fish food and habits, of varying spawning periods and the feeding and spawning grounds, as well as the various and constantly changing methods and devices of the law breaker. These laws must have the moral support of local public opinion; they must be wisely drawn and promptly and discreetly enforced; they must admit of proper discrimination to avoid hardship; and any mistakes or defects be capable of prompt remedy, to adapt the penalties to the varying circumstances. Defects in the fisheries laws to adapt them to the widely varying surroundings of particular localities will be more suitably remedied by a speedy appeal to the

State Legislature, than by recourse to a distant and overburdened Congress. The speedy and continuous vindication of the law against the repeated assaults by reckless and unprincipled fishermen, who are spurred on by the hope of great present profits, can far better be entrusted to numerous and easily accessible local tribunals than to distant and leisurely Federal courts. While uniformity of rules and regulations, which seems to many the highest and almost the sole desideratum, undoubtedly has its merits, it is manifest that a discriminating and readily adapted legislation, vigorously enforced by local officers, prompt to respond to public interests, will be more effective than general ironclad regulations made by a National Fish Commission and enforced by United States officials, practically irresponsible to local sentiment. Practical experience has demonstrated that anything in the nature of police regulation is, in the long run, better left to the control of local authorities, administered by local officers before local tribunals. Local self-government has long been recognized as the strongest bulwark of popular sovereignty and the surest guarantee of our free institutions.

In strange contrast to the persistent advocacy here of Federal control and supervision of the fisheries, is the course of our neighbors over the border. In Canada a determined effort is now being made to have the control of the local fisheries taken out of the hands of the Dominion and given over to the Provinces.

In conclusion we commend the sentiment expressed and the course recommended in the resolutions adopted at the Hamilton meeting, quoted above, and which were formulated by the Michigan Commission and spread upon its records soon after the adjournment of the last meeting of this Society, as a refutation on the part of the members of that commission of the action of this society in passing the resolution mentioned at the beginning of this article.

After the above was read, the following remarks were made:

MR. DOYLE—I think the question should be brought up. We have been fighting the menhaden men as to the purse nets. We would like to get, as Judge Potter suggests, an expression of opinion in regard to the attempt of the menhaden people to take away from the State authorities the control of the State Fisheries.

MR. BEAN—Before the Fisheries Society takes any action on this resolution of Judge Potter, I should like to say one thing of the United States Fish Commission. I do not say it officially. I have no right to speak for the commissioner, but I know, and I think it must be very well known to the gentlemen of the Fisheries Society, that this is not a bill which originated with the UnitedStates Fish Commission; the United States Fish Commission have no desire to control State fisheries, and I think it is perfectly clear to our members that it is merely an effort on the part of the menhaden interests, or some other private fish interests, and we should not be misled by it.

MR. DOYLE—I had no desire to reflect upon the United States Fish Commission.

MR. BEAN—They are not connected with it in any way and disclaim any responsibility for it.

MR. DOYLE—We know the United States Fish Commission are not pushing the bill.

THE PAST AND FUTURE OF FISH-CULTURE.

An Historical Glance at the Cultivation of the Waters.

Under the above title Mr. C. Raveret-Wattel has sent an interesting paper to be read before the society to-day of which I give below an abstract. The paper was originally read at the conference of the National Acclimatation Society, February 27th, 1891.

The review of the history of fishculture given by the author while necessarily brief is very complete. Touching lightly upon the efforts of the ancients to preserve their fisheries, he comes down to modern times and tells us how in the year 1840, during an exceptionally dry year, Joseph Remy, a Vosge fisherman, studied the habits of trout and took from them spawn and milt in a jar filled with water. The eggs proved fertile. This discovery having been made, Antoine Gehin contributed money to aid Remy in prosecuting his researches. Before this, in 1758, one Jacobi, an officer of the Principality of Lippi-Detmold, had fertilized the eggs of trout and salmon and had published his discovery in 1763, but it appears to have attracted no attention.

These discoveries might have been entirely forgotten if it had not been that in 1848 a French naturalist, led by his scientific studies to consider the subject of the increase of fish, presented to the Academy of Sciences a work upon this question. M. de Quatrefages, whose learning and clear judgment enabled him to recognize the importance which the cultivation of the waters would one day take on, did not hesitate to state that it was possible to sow fish as grain is sown, and from this time he proposed to sow the sea. He pointed out the method by which the product of ponds could be regulated; by which the eggs of fish could be used for the restocking

of streams; called attention to the opportunities which these methods offered for the acclimatation and dissemination of species, and in a word traced out at that time a programme of fishcultural industry. As may be imagined, this memoir by M. de Quatrefages created the greatest interest. It was followed by the enthusiastic labors of M. Coste. The fishcultural establishment at Huningue was founded in 1852.

The author discusses the difficulty which the early fishculturalists were obliged to overcome, and touches especially on the importance of fishways. Facts and statistics with regard to fishculture in France, England, United States and Sweden are given, as well as estimates of the money value of fishculture in certain streams, especially as to the cultivation of the shad in American waters running into the Atlantic. He describes the fishcars used in the United States and gives many other details familiar to most of us. The author closes by urging that France, which initiated the science of fishculture, should not stand still and allow herself to be outstripped by other nations.

FISHWAYS.

By W. H. Rogers.

Among the many causes for the decrease of fish in the rivers, as well as along the coasts of this and other countries, the impassable milldam unquestionably occupies first place. A river, as to its production of fish. may be compared to a fruit tree, the larger the tree and the more numerous the branches (other things being equal), the greater the quantity of fruit it will produce; but to girdle it anywhere on its lower part, will effectually destroy its producing capabilities. An impassable dam thrown across the lower portion of a river, has precisely the same effect. as to the production of fish, and most effectually

destroys not only anadromous fish, but almost all valuable river fish as well—for in their search for food, and to propagate their species, almost all river fish are more or less migratory at certain seasons of the year. In proof of this, all sorts of fish inhabiting the Hudson River are seen passing up the fishway recently constructed on the Mechanicville dam, and I have seen them pass up many other fishways, both in Canada and in this country.

The dam, moreover, by preventing the fish from ascending the river, causes them to accumulate below the obstruction, where they fall an easy prey to the industrious poacher of every description.

At this same point also, are found mill refuse, sawdust or poisonous drugs thrown off by the mills and factories, which, from being in bad company, bear much of the odium fairly belonging to the more deadly dam.

Sawdust and other wooden substances may be dismissed as being comparatively harmless, while the poisonous drugs and dyes are usually confined to one side of the river, the fish avoiding them by passing up along the opposite shore, while on rapid-running streams intersected with dams or falls, the water reoxygenates itself at a short distance below the point of contamination. So that, unquestionably, the dam and the poacher are the greatest hindrance to the improvement so much needed and sought after.

Much has been and may be done in restocking depleted waters by the artificial propagation of fish, but where dams exist little improvement has been effected, especially in anadromous fishes, as they descend to the sea, but cannot return to their native rivers, or to the upper portion of them. Therefore, to open the dams with proper fishways, is to add greatly to the value of pisciculture, as well as to directly increase the quantity of fish.

Shad and river herring usually spawn in the still

waters; therefore, the artificial ponds produced by the construction of dams will have the effect of improving the rivers, as to the production of these fish, once the dams are provided with good, passable fishways; and to overcome natural falls, is to allow all anadromous fishes to reach long stretches of inland waters, heretofore inaccessible—a matter of vast importance.

Such considerations as these add immensely to the importance and value of fishways, especially when it is remembered that the improvement of the river fisheries, which send out to the bays and harbors their annual supply of young fish, brings the coast and sea-fish near the shores, and into the estuaries and bays, where they can be more readily caught.

Did the people generally more fully understand the facts in relation to this matter, and its inevitable effect upon food as well as game fish supply, I doubt if in five years there would be a dam or fall in this country, unprovided with a proper fishway.

Facts and statistics are at hand to clearly prove all I say here, but time forbids their reproduction. I may say, however, in a general way, that all the rivers in Canada that have been provided with good fishways for a number of years, are filling up with fish at a rapid rate—so much so that in many places the people living in the neighborhoods are surprised.

A proper device to fully reconcile water power and the fisheries, has been long and industriously sought by parties and countries interested, but chiefly by those who have had little experience or practical knowledge of the nature of the many difficulties to be overcome. Many inducements have been held out with a view to calling out the inventive genius of mankind, and the accumulation of plans and models at the London International Fisheries Exposition, were numbered by scores; but two only of which received any notice at the hands of the judges whose duty it was to pass upon their merits.

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A fishway, to be successful, must be one that can be applied to all forms of dams and natural falls, one that will provide a slow, natural stream at all heights of water, with the entrance for the fish close to the obstruction and placed where they will readily find it, and one which will not injure the water power on the smallest stream. But after such a device has been produced, much experience in the location and construction is necessary, or failure is almost sure to follow; because almost all dams and falls have difficulties to be overcome, entirely their own, which must be met by the proper application of the fishway to the obstruction. To employ an inexperienced man to do this work, is to invite failure in a great majority of cases. Large sums of money have been lost by the adoption of such mistaken methods to master difficulties which only an expert can accomplish, and such is the nature of the obstacles to be overcome, that even a man of experience may sometimes make fatal mistakes.

So far as a decision of the merits of any form of fishways is concerned, the proofs must be supplied by the fish themselves, in the rivers at the dams, for gold medals and other prizes given at expositions and world's fairs are liable to be awarded upon theoretical devices which too often fail when put to actual test.

In this as in most other cases, an ounce of fact is worth more than a pound of theory.

The Rogers' Fishway, which is now in successful operation on many dams and falls in Canada as well as in this country, fully and completely meets all the foregoing conditions and requirements. Its width, five feet; depth, two to three feet; form of internal construction and resultant, slow and unbroken stream, are each and all indispensible in a successful fishery; in these respects it is different from any other in use on either side of the Atlantic and can be constructed at moderate cost so as to successfully pass any sort of

river fish over dams or falls of any height and to effectually resist ice, drift logs, trees or stumps, etc. It cannot be carried away by freshets, unless the dam itself first gives way. It is also constructed so as not to interfere with the permanency of the dam or efficiency of the water power and only in rare cases is it necessary to cut the obstruction or to remove a stone in it.

This fishway is not a mere invention, thought out by a theorist who had but a vague idea of the numerous obstacles to be mastered, but is rather a growth, a detailed mastery of all the difficulties met with down in the rivers amongst the fish and the dams. It is the outcome of a quarter of a century's personal experience, close observation and anxious effort. It leaves nothing to be desired in a successful fishway, which it is possible to produce, therefore there is no need in longer spending money in fruitless experiments on theoretical and useless devices as in the past, but address ourselves to the more practical work of passing the fish up the stream as fast as possible.

After the paper was read Mr. Gilbert said: Within the last twenty or twenty-five years there have been a great many fish-ways invented and devices to get fish up the rivers. I have no doubt many of them have been successful. The State of Massachusetts put in a fish-way at Holyoke. We have also had very expensive fish-ways constructed at Lawrence, Manchester and all the falls. Yet the results, as given by the Massachusetts Fish Commission in their last report in relation to shad, which says, "Returns show a catch of only 12,451 shad taken inland waters, a decrease from last year of over 2,000," are not encouraging Why is this? If we have these fish-ways, on which the State has expended large sums of money to build and maintain, and yet we have the mortifying result that the shad are decreasing, why is it?

The fact is that while the State has expended thousands of dollars to get the fish up, they have never expended one cent to get them down. They have overlooked that. On streams which are not given to manufacture it is very easy to get up and go down over the falls. But on rivers like the Merrimac and the Connecticut, used for manufacturing purposes, how are those fish to get down, especially during the season when these young shad go to saltwater, which is along in July and August, when the waters of the Merrimac and Connecticut are low. It is true a little water may run in the fish-way; but it is the habit of all these fish in descending and ascending a river to go where the strongest current is through the wheels. The fish of the Connecticut and the Merrimac, ninety-five per cent of them I venture to say, go through the wheels. And what are those wheels? They are a tub and wheel. And a fish an inch and a half long can no more go through that wheel than he can go through a meat chopper. Nothing can go through. What are you going to do about it? There is only one thing, and that is to stop the manufacturing or else take out the wheels. Years ago, when the Mill act was passed, overshot wheels were universally in use. Now, a fish can go through an overshot wheel without any danger. It is a very important consideration how you are going to get fish down. At the Russell mill, where I have been employed for a number of years, rather than to put a fish-way in, they carry the fish up, cart them up and put them into the river above. There are millions hatched there but there is not one goes down through alive.

Mr. Rogers—My experience of a quarter of a century in this matter is that young fish have no difficulty in finding their way down. Herrings and shad go down is September in that country; during that month, all of that month. There is abundance of water going over the tops of the dams, and fish can go down wherever water goes. I have investigated the wheel idea, and I have known

young fish to go through by thousands, and go through alive; through the (tribune) wheel, which is a wheel that receives its power from specific gravity, and the fish goes through as a part of the water without being hurt at all, unless they happen to strike and get a little stunned, but they come to life when they get below. This is my experience. I bow to any facts the gentleman knows, of course, but I assure you there is no difficulty in a young fish going down any river in this country,

MR. FORD—I think the greatest works are those that have been recently accomplished jointly by the New York and Pennsylvania Fish Commissions in the fish dam at Lackawaxen over the Delaware River. They are the Rogers Fish-ways and by them we have been enabled to allow the shad to ascend the Delaware River. They are most efficacious. They have sent the shad up nearly a hundred miles above the Lackawaxen dam, and that they come down again, I can say from personal observation. Not only the large shad come down the fish-ways, but during the summer time, in August, September and October when the young shad comes down, the river almost glitters with the shad leaping from the water. There is no trouble about shad coming down the fish-way. They have had that much more spawning ground added, nearly a hundred miles more of water. They have gone up the fish-ways in such numbers, that in the next stage up above in New York State, in the report made by the New York Commission in 1891, this is spoken of as a solid mass of fish waiting under the dam to get up, and the report calls upon the New York Fish Commission to put fish-ways up there to let them go further.

DR. HUDSON asks the height of the dam.

MR. FORD—I think about eight feet. The fish-ways work to a charm. We have lots of them in the dam across the Susquehanna River, a very long dam, and shad have been going in considerable numbers forty to fifty

miles above that dam. It is the purpose of the commission to add fish-way after fish-way until we can finally send the fish up again to New York State line, where formerly they were caught in larger quantities than they are caught in the Delaware to-day.

MR. ROGERS—At Mechanicville Dam, a stone structure sixteen feet high, fish were jumping there, salmon, trying to get over. I saw six in one pool close to the dam; Two of them would weigh thirty pounds. Those salmon, as soon as the fishway was done, went right up. My son went through the fish-way from bottom to top and found fish in every apartment. Last year a large number of salmon were caught away up at Baker's Falls, fifty miles above the dam.

I also put one in the Northumberland dam, thirty miles above, and they went through that.

MR. CARY—Do you know positively that shad ever pass up through? It is well known that salmon will go everywhere that shad will.

MR. ROGERS—If they can send shad over the Troy Dam, they could over the Mechanicville Dam. I have put shad over a dam in Canada seventeen feet high.

MR. CARY—Is it positively known that they did pass up!

MR. ROGERS—Yes.

MR. POWELL—About the young shad being destroyed going to the sea. It has been a good deal of discouragement to our commission. We have four hundred miles of fish water, useless for commercial purposes, full of islands. We try to propagate and protect those fish. We have been trying for years to get the State of Maryland to join with us to pass laws uniform to our State. We are making a great effort to keep those fish there from passing out. They have twelve miles and we have four hundred. It is very discouraging for us to raise those fish and let those people catch them in twelve miles.

In regards to these fish-ways, I have a letter in my

hand which I wrote to a party to know whether they had any fish caught at their station (Newport). This letter states that there have been only seven caught on account of the flood, all small male shad about two and a half pounds apiece. Mr. Rogers I presume will explain that from the fact that the females follow the male.

MR. ROGERS—They got them in a dip net. Shad keep out in the current and these dip nets are on the shore; that would account for the small quantity caught. The male fish both in salmon and shad, go ahead of the females; the females come up later.

THE SUSQUEHANNA.

ITS PAST, PRESENT AND FUTURE.

BY A. F. CLAPP.

THE Pennsylvania Canal Company commenced building dams as feeders to its system about the year 1826. Previous to that time the Susquehanna River had been one of the most prolific for at least three species of anadromous fishes, the shad, the herring and the striped bass or rock fish, as good fishes of commercial value as any of the Atlantic coast series, and besides these there was an abundance of non-migratory species which furnished ample food for the dwellers along and in the vicinity of its shores. From the time of the erecting of these obstructions commenced the gradual decline of all species and the total loss to all dwellers above of all the migratory tribes except the eel, which found its way through rifts and crevices. Soon other factors of destruction became operative, notably soils washed in from cultivated lands, and later, the immense quantities of debris from the anthracite coal fields which now covers the bed of the river in all pools and eddies, to the almost total destruction of the natural spawning grounds and

life of the eggs, from the Lackawanna coal fields at Scranton on the North Branch to the bay at Havre de Grace. The time is also not far distant when the same condition will obtain in the West Branch, from the bituminous field of clearfield and above, unless a halt is called, and all this deleterious matter is made some other disposition of. As far as relates to soil wash, it seems unavoidable, but proper legislation and enforcement of the laws could remedy the other. The sulphur impregnated water from the mines acts only locally and is gradually desseminated and purified, but to the abatement of the dumping of mine refuse into the streams tributary to the main river must we look if the waters are ever to be again rehabilitated. The dragging of seines over the spawning beds, catching the gavid fish from off their nests and covering up the spawn already deposited has been another fruitful source of depletion. There are laws to deal with this feature, and the fault lies in the proper enforcement. Up until the early seventies when artificial propagation and restocking was introduced, the supply of all classes of food fish had gradually diminished until the waters was almost barren. Striped bass, shad and herring had disappeared with the erection of the dams, while the pike perch, locally termed the Susquehanna salmon, the pickerel (*Es. ret.*) the yellow perch, the sunfish and catfish, the most esteemed of the non-migratory fishes, had almost entirely disappeared. With the organization of our fisheries commission, about 1870, began a practical regeneration. The black bass, as a new variety, has proved wonderfully prolific, and several others of the smaller perch family have obtained a fast hold. These waters seem best adapted to the precoids, and greater efforts in stocking with this species ought to be persisted in. The reintroduction of wall-eyed pike or pike perch has been manifesting itself in increased numbers very perceptibly. When fish propagation assumed important proportions,

we had hoped much for this river as a fit habitat for the Pacific salmon, and many hundred thousands of fry were placed in the upper Sinnemahoning and other tributaries only to remain a year or two as smolts and parr and then disappear. Only one adult specimen did I ever see or hear of, and that came ashore here dead, killed probably in some log jam above during the June freshet of 1889. This specimen would, I estimated, weigh about thirty pounds and was in prime condition, too much putrefied to remove from the water, but was an undoubted quinnat salmon. I gave an account of it at the time to FORREST AND STREAM and to T. H. Bean at Washington, but saw afterward that he was probably in Alaska, as I got no acknowledgment of my letter. Trout (*Sal. Font.*) were common in the early years of the present century, but as the settlements increased, the forests became depleted, the water roiled and temperature increased, they decamped for cooler and purer springs.

I have been familiar with this river for forty years and have followed its changed conditions with much interest and with increasing alarm unless the public can be roused up to effective effort for its preservation. The future of our noble river, with its broad expanse, looks gloomy indeed, and not only the Susquehanna, but is it not true of most of our American rivers? And what can we hope for but depletion unless intelligent public sentiment can be aroused to arrest the destructive influences. Our Fisheries Society is doing its best and exerting a healthy influence, and it is with the view and hope of discussion, and efforts that may eventually lead to more important results, that I respectfully submit this paper for your consideration.

SUNBURY, PA., May 16.

The following discussion took place:

MR. POWELL—We have been asking for the last three or four months to get an opinion as to coal countries, and the people who are running this water into the streams, and whether it would be advisable for us to make a test case against one or more of these companies. But up to this time I cannot get any official opinion. I was invited by this society to prepare a paper on the subject, but could not get the data together to do so as quickly as I would like to. It has got to be one of the most important questions. It appears in certain counties north of us here that there has been a waste of coal dust, possibly for years—fifty years. Somebody devises a patent to wash this coal dust out, pass water through it, and selling it for fifty or sixty cents per ton right on the ground. We get all the water and they get all this cheap coal. It goes further than that: I can name a dam near Harrisburg where sand diggers are digging fine coal out of the bottom of the river. It not only keeps the water back, but it is destroying all the food that the large fish live on. Possibly for two or three or four hundred yards from shore, the bottom of this river is covered with this coal dust. It is going to be an important question; I have had a number of letters from other States in regard to it.

AMERICAN SALMON AND OTHER FOOD FISHES.

By Prof. Bushrod W. James, A.M., M.D., Philadelphia, Pa.

While all who are interested in the great question of the protection of the seals in Bering Sea are waiting anxiously to hear of the final arbitration decision, we may turn a while to the study of the interest whose promise seems to be great in regard to both money making and the more plentiful and less costly supply of a very desirable food, the Salmon.

Western salmon eggs have been carried in safety to the rivers on the eastern coast, and no doubt they will soon yield abundantly; the shad fisheries in the Delaware have been saved from dissolution by artificial hatching, the return having been raised from 60,000 to 500,000 within a very few years.

German carp and English brown trout take very kindly to our smaller streams and sluiced ponds; there is no doubt that they would become plentiful if they were properly protected; but from the very small boy with his string and crooked pin to the more nobly equipped man of leisure, all seem to think that each alone has the privelege to take fish from whatever quarter in which he sees they are abundant, and it is just possible that a depleted private pond is the victim of some such marauder instead of having been visited by kingfishers, water snakes, or other disastrous visitants. The number of enemies from whom fish suffer has always been so great that nothing but their extreme productiveness could have saved them from total extinction long ago. And when we think of the popularity of weir and seine fishing, it is wonderful that there are any of the more desirable kinds remaining! even in the Karluk River, on Kadiak Island, Alaska, the most productive salmon fishing ground in in the United States, there is a perceptible decrease in the number of fish caught in late years, which is ac-

counted for by the use of the large seines, which not only make immense hauls of fish useful for canning, but they catch the breeding fish which they prevent from ascending the minor streams for the purpose of spawning; thus not only destroying the fish that is not good for food, but preventing the propagation of the species. Other valuable fish are caught with the salmon and ruthlessly cast aside to die on the beach, where they lie decomposing by thousands. In Pennsylvania the laws have prohibited weir fishing, and the increasing numbers of fish in our streams show the wisdom of the commission in obtaining such protection. If the United States Commissioner could secure such lawful safeguard for the salmon of Alaska, it would insure an almost interminable future for the vast industry in the territory, whose canneries would one day be able to supply the world.

The planting of fish fry is an undertaking which requires wisdom in the selection of the waters for the purpose, and a careful regard to the habits of the finny occupants. A voracious variety of fish for instance, will sometimes clear all other species from the pond or stream in which they are placed; black bass has this reputation, therefore the folly of trying to raise trout with the rapacious varieties in the same stream is apparent.

Perhaps there is no industry that makes more ample return than that of catching and preparing fish for the markets. In Alaska the canneries yield an immense profit, and they deal in salmon alone, the yield of halibut, cod, and other kinds of fish is not included in the vast industry; but Alaska herring and smelts are said to be particularly fine and no doubt they will soon attract capitalists to set up a strong rivalry with other parts of the world in their production for the markets.

The supplies of cod, mackerel and herring from the eastern coast has so long been an institution, that remarks concerning them seem superfluous; perhaps too, no one can fully appreciate the great importance of these

fisheries to the inhabitants of the eastern coast, from Labrador to Nantucket, unless it were possible to cut off entirely for a time, the yields of fish from the bay of Fundy to Long Island Sound, we could not estimate how many of the citizens are dependent upon the products of the sea. As it is, the alarming diminution of the catches of mackerel, cod and lobster in those eastern states has gone far towards ruining some of the minor towns along the coast.

The greed of speculators, who saw how well the fishermen were able to support themselves and their families with their primitive modes of obtaining their stock for trade, and who introduced purse-seines, drag nets, trawls, and weirs, thereby catching enormous quantities of fishes in all stages of their existence, and with blind fool hardiness glutting the markets—have bestowed upon the born fishers a trial, from which the older members of the community can never recover, by draining the bays and coves of the larger and more valuable of all kinds of fishes. Those which their devices did not catch have been so frightened that they have left the runs; and unless the United States laws interfere with decisive and immediate exercise of their power, and forbid the use of those modes of fishing; both old and young inhabitants will forsake the coast, take up with some other industry in order to gain a living; or, worse still, they will leave their native land and go to the Canadian shores, from which even now there are great quantities of fish imported into this country.

But let us hope that no such disaster may befall our honest fishermen and our eastern states; instead, we must strive by every measure to increase the numbers and varieties of the beautiful food fishes, and to have laws enforced for their permanent protection.

Perhaps because there is a greater proportion of water than land on the face of the earth, there is no more universal article of food than fish in existence. Among the

most refined epicures, or on the tables of the poorest classes in nearly every country, fishes of various kinds take an important part. The daintily prepared salmon or trout, followed by other luxuries in one household, is represented by mackerel or herring in another, with perhaps no other addition to its savoriness than its rival staple, bread. In fact there are few people of any grade who are not fond of some one of the silvery denizens of the water; and from humanity down to the smallest warm blooded animal, from the greatest mammal of the sea to the smaller fishes; even reptiles are fond of fish and all wage a constant war upon their numbers; and how many, both human and animal, derive their whole sustenance from this one source alone.

There was once a prevalent idea that fish had a peculiarly nutritive effect upon the brain; science does not substantiate that notion, but undoubtedly in a piscatorial diet there must be considerable health and strength. One attribute of such nutriment seems to be tenacity of life. Among the Esquimos, for instance, there are tribes who live exclusively on fish, seal meat and oil, and a few berries; they have no salt. The fish is broiled when fresh, eaten raw when dried, and some even consider putrid fish heads a most delicious dainty; they live in underground huts with no ventilation of which to speak; they fairly reek of fish, and yet some of them live to quite a good age. This goes to prove that there is a vast amount of nutrition in the food, and that the careful propagation of the best food fishes of the world is a noble and necessary employment.

Among all the finny tribes, salmon and cod of the larger fishes, trout and mackerel of the smaller, seem to be most important. from the salmon fisheries of the north-west alone there is derived an enormous profit; Columbia River salmon has long been classed as the finest in the world, but Alaska is steadily advancing until it has already come into favor equal in many ways with the

Columbia. Some writers say they are the same fish, others claim distinction, but they are both very fine, and that the canneries have acquired a prominent industry in the territory, none will dispute.

Of Alaska salmon there are five prominent varieties, each with special points of favor among the natives.

The KING SALMON is the finest of all in flavor but its color is not so beautifully tempting as that of some other varieties. Its average weight is twentv pounds, though some have been known to attain a weight of seventy-five or eighty pounds. The king salmon is claimed to be the identical Columbia River salmon, whose repute is world wide, and which grow to an enormous size. I have seen specimens along the Columbia River at the canneries, which weighed about eighty pounds and looked as large as an ordinary sized man.

In Alaska, salmon fishing and packing has not attained very great commercial importance as yet, because this fish runs most numerously in the Yokon River, and its tributaries, which are so distant from the markets as to make the expense too great for the undertaking, No doubt an early day there will be canneries established and good modes of transfer furnished to ambitious merchants; and when the Columbia fails to give such vast supplies, the Yokon will provide for all deficiencies in that quarter.

During the running season the natives are wild with delight; they feast upon the fresh fish, but do not store it as they do some of the families, perhaps because it cannot be caught in the great quantities that they are able to obtain of the other kinds. The greatest drawback to the king salmon for importance in the markets is that it is difficult to catch them in large numbers on account of the rough waters in which they run.

The DOG SALMON is a favorite with the natives, who make feasts, dance and make gifts to the river Gods who permit them to come in such quantities for their delec-

tation. These and the hump-back variety are the kinds most used for drying and preserving for winter use, as well as for barter with the northern traders. The dog salmon is found in nearly every river in Alaska, even very far north, and its extreme abundance is one trait for which it is favored by the Alaskans, though it is much smaller than some other kinds.

The SILVER SALMON is not so important as those before mentioned, though they are used for canning in some places. They arrive late in the season, which may account in a great measure for their being less popular The supply is generally laid in, and the hungry natives have sated themselves before their tardy arrival; therefore they are not so eagerly sought. This is one of the nest building fishes, whose curious habits have been the study of scientists. They actually wear their snouts away in pushing the stone in place for their nests.

The HUMP-BACK SALMON is the smallest of the Alaskan salmon, and the most abundant. These are the fishes of which it has been said they are more numerous than the drops of water in which they live! The natives catch them with sticks filled with nails, which they plunge into the schools, and by which they get enormous returns by simply scraping them up and flinging them ashore to the women who are in waiting, and to whom the duty is entrusted to disembowl them and prepare them for drying. The wildest excitement greets their coming, and the people simply gorge themselves with the fat products of their fishing. This fish is another that is yearly abundant and widespread over the territory, but it has comparatively no commercial value, because of its being remarkable for its rapid decomposition on exposure to the air.

The RED SALMON is the one now holding the most merchantable importance of all the salmon tribe; and in this case, as in many others, beauty has supplanted merit, for the flesh is really not so palatable as that of the king

or the silver salmon, but its rich red color has become so desirable that other kinds are filling subordinate places for the present, at least.

These poor little fishes have many difficulties to surmount: They run in very turbulent waters, they are sought after by man and beast, they have been threatened with extermination by the excessive greed of those who would like to take the season's catch in one great haul. And yet they are very abundant so far. Just here comes the opportunity for the question of the protection of the fish—not only of the salmon of the great North-west, but of the beautiful food fishes of our own immediate streams and rivers as well.

I note a successful exchange of edible fish with Great Britain, with apparent favorable results. Now, if foreign fish will thrive in interchange, I think there should be wider diffusion of the varieties in the waters of the United States.

Alaska is not limited to salmon alone, though it is most useful of all; there are trout, greyling, white fish, and many other small fishes; and the black cod, the sturgeon, and the famous halibut; all grow to perfection in the pure, snow-fed waters of the territory.

The value of the salmon alone is wonderful, and it may be increased with no apparent limit for years. In 1889 there were thirty-six canneries in operation, representing an outlay of four millions of dollars. A vast sum, but the product of the year was estimated at three millions of dollars. Certainly a good interest for the money expended.

While we are speaking of the enormous products and profits of the West, we must not forget the steady, plodding industry of the East, where for years the sturdy fishers have gained an honest living. They smile at the wild stories of the North-western fisheries as if they thought it was but a flash in the business that will soon settle to a quiet, rather uncertain status such as their

own; and so it will, in shorter time than it required for the coast of Maine to attain its present quietude, if the wholesale slaughter of all sorts and conditions of the defenceless creatures is not discontinued.

Fishculture, and the protection of the breeding fish and of the young fry are becoming more decidedly urgent each year; but the Government has taken the matter under its own protection, and now we need no longer fear the extinction of some of the favorite finny races.

I think there is no sport more truly widespread than that of the fisherman. It passes through all grades of society, from the dainty lady who wants to fish but screams at the sight of the necessary worm, to the sturdy aleut who only rejoices in it from its positive necessity for the sustenance of his family; yet one could envy him the myriads of pretty, silvery creatures waiting for his barbed stick, while our Eastern rivers hold such chary beauties that no coaxing with dainty morsels can win them to the hook. And yet the fascination returns periodically. The fisherman takes his basket, his hook and line, or flies—as the case may require—he starts off hopefully, his appetite already sharpened with the bright promise of the day's sport; and if he returns with nothing but a very hungry stomach, very delapidated clothing, and a weight of weariness upon him, he will forget it all and be ready for the next season of trout or salmon! North, South, East and West, it is the same. And as if in indulgence to the love of the sport, there is nothing so prolific as fish. Produced by the million every year, they are surely sent for some great good.

From the coarse grained cod of the north-east, to the delicious salmon of the north-west; from the bulky halibut to the slender speckled trout; from the northern mackerel to the highly flavored shad; all have their votaries; all take their places among the most valuable living productions of the world; why then should they not be carried from one part of the Union to another?

Why should they not be protected from destruction? Artificial hatching has so far been successful so that there need be no limit to the production of graceful fishes that may swarm our streams and reward the patient fisherman for his hours of anxious waiting and his days of disappointment.

And now a few words concerning the diseases of salmon: Apart from all other enemies to which salmon are subjected, even in the pure waters of Alaska, nearly all are infested with a parasite, of which collections were made by M. McDonald, United States Fish Commissioner, who was appointed to visit and investigate the fisheries of Alaska; his report states that they were not able to classify the species, therefore it cannot be determined whether they are hurtful to the fish or not. Probably in artificial hatching the fish may be freed from the parasite, and then by comparison it can be found whether they are detrimental to the quality of the flesh or not.

The Encyclopaedia Britannica notes a peculiar fungoid growth in the salmon of the rivers in Great Britain which has destroyed many of the fish since its discovery in 1877. I find no notice of a similar disease having been found among the salmon of this country, but it would be well if all who are interested in pisciculture would watch and report the first appearance of any fungus growth among their stock.

The disease takes the form of ulcerations, which eat away the skin, producing inflammation and sloughing, bleeding sores. By examination it is proved that the fungus is the cause, and not the result of any other disease.

The fungus bears such close resemblance to the saprolegnie ferax which is found upon dead house-flies and other decaying animal or vegetable matter, that it has been mentioned as identical with it; but it is not fully proven; neither is there proof that it propagates so quickly among the salmon as to become epidemic.

There seems to be a wide field for investigation in regard to this fungus, and it would be advisable for all who are engaged in the business to watch closely and give opportunities for a thorough study, if any disease of the kind threatens the fish under his supervision or observation.

The following discussion took place:

MR. CARY—I would like to ask one question in regard to the paper: If I heard correctly you allude to German carp as being a predacious or destructive fish to other fishes?

MR. JAMES—Where they cannot get their own food. It is so stated in the report I read some time ago, that the German carp would live on its own kind of food—which is vegetable food—but rather than die, it will consume its own kind.

MR. CARY—In connection with this, there was an article published in Ohio, alluding to this fact, speaking very much against German carp as being predacious fish. I have had a good deal of experience with the German carp in the State of Georgia. We have no evidence that they are to any extent. If a large number of carp were confined in a small space, I suppose they would eat one another sooner than perish; but I don't think unless I have sure positive proof of it, that German carp is predacious.

MR. JAMES—Where they cannot find sufficient vegetable food. They are a rapidly growing fish and require a great deal of food to make them grow in that way; and that is the statement that I got from an article which led me to introduce it in the paper. They are not usually a voracious fish as such.

MR. MATHER—I think the ichthyological portion of that paper on the Alaskan salmon is exceedingly good. I am glad as an ichthyologist that the subject came up. Dr. Bean published something on it I believe.

A NATIONAL SALMON PARK.

By Livingston Stone.

Who would have thought thirty years ago that the creation of a National Park in this country would be the means of rescuing the buffalo from extinction? Who thought then that anything was needed to rescue the buffalo? The buffalo roamed in myriads over the plains and mountain slopes of the central portions of the United States and were so innumerable that, with the exception of a few far-sighted persons, no one thought that this noble race of animals was even in danger. The supply seemed inexhaustible and the species at least safe from extinction.

How soon we found out our mistake, and how suddenly the change came. The note of alarm had hardly been sounded long enough to be distinctly comprehended over the country, before the buffalo was gone—all gone practically, except a few straggling survivors which, if they had not found refuge in Yellowstone Park, would have been gone too, long before this. The Yellowstone National Park saved them. It saved the wild race from extinction, and if nothing else should ever be accomplished by the creation of the Park, this alone would, in the writer's estimation, justify its existence.

But if anyone had said thirty years ago, "Let us form a National Park in the buffalo region for a protection and refuge for the buffalo," the proposition would have been laughed down from one end of the country to the other. It would have been thought a most ridiculous expedient, a scheme too foolish and crazy to be even seriously entertained. Nevertheless, the creation of the National Park has accomplished this very object, and has been, I think it may be safely said, the only means of accomplishing this most important object, the preservation of the American buffalo.

Now what this paper is going to propose will appear,

doubtless, just as ridiculous, just as foolish and crazy, as the formation of a park for the preservation of the buffalo would have been thought thirty years ago. It is nothing less than the creation of a national park for the preservation of our salmon.

I hear already from all directions the question, "What do the salmon need a park for? Are there not plenty of places of safety for them already in all the rivers and streams of this country, not to mention the pathless ocean where man cannot follow them?"

It looks so at first sight, I admit; but let us try to find these places of safety if they exist, and then see how it looks. We certainly cannot find them on the Atlantic coast, where the scanty yield of the only two American salmon rivers—the Kennebec and Penobscot—is only a drop in the bucket compared with the total consumption of salmon. Passing over to the Pacific coast we find only the Sacramento, the Columbia and the lesser streams on the Washington and Oregon coast, and in all these the salmon are about as safe as the fur seals were last year in Behring Sea.

I will say from my personal knowledge that not only is every contrivance employed that human ingenuity can devise to destroy the salmon of our West coast rivers, but more surely destructive, more fatal than all is the slow but inexorable march of those destroying agencies of human progress, before which the salmon must surely disappear as did the buffalo of the plains and the Indian of California. The helpless salmon's life is gripped between these two forces—the murderous greed of the fishermen and the white man's advancing civilization—and what hope is there for the salmon in the end? Protective laws and artificial breeding are able to hold the first in check, but nothing can stop the last.

To substantiate this statement, which may seem exaggerated, let me inquire what it was that destroyed the salmon of the Hudson, the Connecticut, the Merrimac

and the various smaller rivers of New England, where they used to be exceedingly abundant? It was not overfishing that did it. If the excessive fishing had been all there was to contend with, a few simple laws would have been sufficient to preserve some remnants, at least, of the race. It was not the fishing, it was the growth of the country, as it is commonly called, the increase of the population, necessarily bringing with it the development of the various industries by which communities live and become prosperous. It was the mills, the dams, the steamboats, the manufacturers injurious to the water, and similar causes, which, first making the streams more and more uninhabitable for the salmon, finally exterminated them altogether. In short, it was the growth of the country and not the fishing which really set a bound to the habitations of the salmon on the Atlantic coast.

Let me illustrate this same statement more in detail by presenting the testimony of the salmon rivers of the Pacific coast. Take for an example the Sacramento. When the first rush of Gold seekers came to California in 1849, every tributary to the Sacramento was a fruitful spawning ground for salmon and into every tributary countless shoals of salmon hastened every summer to deposit their eggs. When the writer went to California in 1872, only twenty-three years later, not one single tributary of the Sacramento of any account was a spawning ground for the salmon except the McCloud and Pit rivers in the extreme northern part of the State, where the hostility of the Indians had kept white men out. It was not fishing by any means that had caused the disappearance of the salmon, for the miners did very little fishing in those times; but it was the debris from the quartz mines which drove the salmon out, ruining the spawning grounds and rendering the river uninhabitable for the salmon.

This was in 1872. In 1878 the writer took 14,000,000 of salmon eggs from the summer run at the U. S. Sal-

mon Station on the McCloud river. In 1883 the Southern Pacific Railroad Co. (then the Central Pacific) extended their line northward up the Little Sacramento, crossing the mouth of Pit river, into which the McCloud empties a mile or two above.

So disastrous to the salmon was the effect of the road building along the Little Sacramento and the mouth of the Pit, that that year it was with great difficulty and only by very hard work that we succeeded in getting barely 1,000,000 salmon eggs, and the next year Prof. Baird, in disgust at what he considered the unpardonable indifference of the Californians, discontinued taking salmon eggs at this station. Since that time sawmills of immense capacity have been erected at the head of the Little Sacramento and the McCloud, and have done very effective work in increasing the now alarming scarcity of the spawning salmon of the Sacramento.

I think these instances are sufficient to show that what the friends of the salmon have to fear more than overfishing, is the growth or development of the country always attendant upon an increasing population, but the fatal consequences of which to the salmon it is impossible to avoid. Nothing can stop the growth and development of the country, which are fatal to the salmon. For instance, there was no power in the world that could have prevented the mining on the Feather, the Yuba, the American Fork or the other spawning streams of the salmon; nothing could have stopped the building of the railroad up the Little Sacramento or the erection of the Sawmills on the upper McCloud. They came along naturally and inevitably in the march of events, and they could not be withstood; and nothing was left for the salmon but to suffer the consequence and disappear as by a decree of fate.

Now actual fishing in the salmon streams can be regulated by law and rendered comparatively harmless, but the country will continue to grow more and more populous and

the fatal march of civilization will proceed as irresistibly as ever. That cannot be held back, and unsafe as the salmon are now in our Atlantic and Pacific coasts rivers, they will become more and more unsafe every year; all of which goes to show that there is no safe place for the salmon within the limits of the United States proper.

This leaves us only Alaska. Now, how is it with the salmon streams of Alaska? Not even there are the salmon safe. Countless myriads of salmon formerly filled all the rivers and streams of the long Alaskan coast, and they were nearly 2,000 miles from the destroying hand of civilized man, but they were not safe even on those distant shores. The ubiquitous canneryman found them, and he already has his grip on the best and most fruitful of the Alaskan rivers. The pressure of the world's demand on the world's supply of canned salmon renders it necessary for the salmon canner to occupy more distant and less fruitful fields every year, and it is only a question of time when all the Alaskan salmon streams are given over to the canneries, and when that time comes no one will claim, I think, that the salmon are safe in Alaska.

One or two illustrations are sufficient. The Karluk River on Kodiak Island is probably the most wonderful salmon river in the world. On Aug. 2, 1889, the cannery nets caught on Karluk beach at the mouth of the river, 153,000 salmon by actual count. A short time after, the writer went up the Karluk River in a bidarka—the skin boat of the natives—expecting to see myriads of salmon spawning and thousands on their journey to the spawning grounds, but instead of the wonderful sight we anticipated, our whole party, I think, saw less than a dozen in the river till we reached the lower spawning grounds, and then to our astonishment we saw only a few scattering fish spawning, such as one might expect to see in the most commonplace salmon river in the world; 153.000 salmon caught in one day at the mouth of the river, and none to speak of going up the river to reproduce their

species. Every one can draw his own inference, The fact is significant enough.

On another river, a large one, the Nushagak, where vast numbers of salmon were taken at the mouth one summer for canning, we were told that the succeeding winter the natives living up the river were brought to the verge of starvation because the salmon which they had always depended on for their winter's food were so scarce. Of the thousands and thousands of salmon that usually ascend the river to spawn, not enough spawners escaped the nets at the mouth to keep the natives on the upper waters from starving. This fact speaks for itself also.

So much for the safety of salmon in Alaska in general, but it would yet seem that on the uninhabitable shores of the Arctic Ocean the salmon might find a place of refuge, but not even there can they stay unmolested, for parties were planning three years ago, the writer was told, to establish canneries on the affluents of the frigid and forbidding Arctic. So we see that our salmon are not safe even in Alaska, their last refuge, and if not there, they are not safe anywhere within the limits of our broad land.

But now the question comes up, "Will not protective laws and artificial breeding make the salmon secure enough?" My answer is that good laws and artificial breeding will do a good deal toward it, but not enough. Good laws can prevent overfishing, but no laws can arrest the encroachments on the salmon rivers of increasing populations and their consequent fatal results to the salmon. No laws could possibly have been enacted which for instance would have stopped the manufacturing enterprises on the Connecticut, or the vast water traffic of the great metropolis at the mouth of the Hudson which doubtless drove the salmon out of these rivers. Protective laws may regulate the salmon fishing of the Sacramento, but no laws can stop the mining, the

logging and the railroad building that are destroying the spawning grounds of the tributaries of the Sacramento. It is not in the power of law enactments to save the salmon from all their dangers.

Artificial breeding can do a great deal, and has done a great deal, but it cannot be relied upon for a certainty. In the first place it is very uncertain where one can find a suitable place for hatching salmon. The writer traveled over four thousand miles up and down the Columbia and its tributaries, from the Continental divide to the Pacific coast looking for a good place for salmon hatching, first in 1877 for the Oregon and Washington cannerymen, and afterwards in 1883 for the U. S. Fish Commission, and found only two places in that great stretch of country which were suitable, one on the Clackamas River where the writer built a hatching station, and the other on the Little Spokane a few miles from Spokane Falls, which is still unoccupied.

There is in all the great State of California but one stream suitable for salmon hatching on a large scale, and on this stream, strange as it seems, there is but one spot that meets all the requirements of the case, and that is the place that the writer selected and built upon, on the McCloud River in 1872, and named Baird, in honor of the distinguished Commissioner, under whose direction the work was done.

Allow me to add by way of conformation that subsequently the State Fish Commission of California, after hunting all over the State for another place for hatching salmon, have given it up and now get their supply of salmon eggs from the Government station at Baird.

The above instances illustrate the difficulty of finding suitable places for hatching salmon on a large scale, and not only is it not easy to find such places, but they cannot be relied upon to a certainty when they are found, for they are always in danger from logging, mining, railroad building, lumber manufacturing and other

causes which yearly become more imminent and dangerous as the country gets settled up and the population increases, and which threaten at any time to destroy their efficiency.

We must come to the conclusion then that even with the help and support of protective laws and artificial breeding, our salmon, like the buffalo of thirty years ago, are not safe. The destroying agencies of advancing civilization drove the buffalo to the last ditch, so to speak, and then the last survivors, or almost the last, were slain. They were obliged from sheer necessity to come to feed. where from all directions the hand of man was raised against them. Whether they turned to the north or to the south, to the east or to the west, they went to their certain death, and in an incredibly short space of time they practically disappeared.

The story of our salmon is analogous. They are obliged to come inland to breed. They are compelled from sheer necessity to come up the rivers into the very midst of their human enemies. They cannot stay in the ocean like other fishes of the sea, where they are safe from the hand of man, but they must necessarily come, one might say, into his very grasp, and, like the buffalo, whether they turn to the north, south, east or west, they go into the very jaws of death; for what hope is there for a salmon to escape after he has entered a river, if man chooses to employ his most effective agencies for his capture? There is none. The salmon is doomed. There is no alter of refuge for the salmon in this country any more than there was for the buffalo.

Ought not something be done, then? Ought this state of things to continue? The salmon of the United States are one of our most valuable posessions. As a matter of ordinary prudence, ought not the country to have some place, if it is possible, where the salmon can come and go in safety? If a stock raiser saw that his cattle were daily diminishing because they had no spot where they were

safe from beasts of prey, what kind of a man would we think he was if he did not very soon fix a place where they would be safe.

We should. to draw it mildly, think he was very improvident and negligent. Is it any less improvident and negligent for this country not to provide a place for its rapidly diminishing salmon where they will be safe? It seems to the writer that not a day ought to be lost, but that if it is possible to provide a place where our salmon can resort unharmed and remain safely their allotted time, it should be given them without hesitation. If there is such an asylum of refuge within our bordefs, by all means secure it for the salmon and let the salmon have it for an eternal heritage.

Is there such a place within the limits and jurisdiction of the United States? The writer can say from personal knowledge that there is one place at least. Most fortunately for us Americans there is in our Alaskan possessions just such a place as is wanted—probably more than one—and so exceptionately fortunate is America in this respect that it is not likely that this side of the frozen and uninhabited shores of the Arctic, it can be duplicated many times in the possessions of all the nations of the earth combined, which significant circumstance, allow me to add in passing, goes to show how near the world has reached the extreme limit of its salmon supply.

The locality which the writer has in mind is an Island in the North Pacific about 750 miles nearly due west of Sitka. Its name is Afognak, and it is the northernmost of the two largest islands of the group, called the Kadiak Islands. It lies just north of latitude 58° and between 152° and 153° west longitude. It is a small island. probably not over fifty miles across at its widest part, but there are several streams flowing from various points of the island to the surrounding ocean. and at the proper season contain salmon innumerable. It is no exaggeration to say that salmon swarm up these streams in countless

myriads. When the writer was on the island in 1889, the salmon was so thick in the streams that it was absolutely necessary in fording them to kick the salmon out of the way to avoid stumbling over them. I know that this story is an old salmon chestnut, but it illustrates as well as anything the wonderful abundance of salmon in the Afognak streams; and it can be easily believed when it is remembered that about a month earlier 153,000 salmon were caught in one day at the mouth of the Karluk, which is a river only 60ft. wide where it empties into the ocean. But there is no need of consuming time in proving the abundance of salmon at Afognak Island. It is a matter of record. The salmon are there in as great numbers as could be wished. All the varieties which also inhabit the Pacific Ocean come to Afognak. The list is as follows; it is a royal catalogue:

1. The red salmon, the "blue back" of the Columbia (*Oncorhynchus nerka*).

2. The king salmon, the "quinnat" or "spring salmon" of the Columbia (*Oncorhynchus chouica*).

3. The silver salmon, the "silversides" of the Columbia (*Oncorhynchus kisutch*).

4. The humpback salmon (*Oncorhynchus gorbuscha*).

5. The dog salmon (*Oncorhynchus keta*).

6. The steelhead, the "square tailed trout" of the tributaries of the Columbia (*Salmo gairdneri*, *Salmo truncatus*).

7. The Dolly Varden (*Salvelinus malma*).

It is easy to see what a paradise for salmon this island is, and what a magnificent place of safety it would be if it were set aside for a national park where the salmon could always hereafter be unmolested. But the abundance and variety of its salmon are not the only recommendations that Afognak Island has for a national park. It has several others which may be enumerated as follows:

1. The island is inhabitable all the year round, with a

comparatively even temperature. Although so far north. the winter's cold is not excessive, probably not equalling that of parts of New England. It is cooler than New England in the summer, it is true, but there is much less variation of temperature between summer and winter.

2. The rivers of Afognak still exist in all their original purity and fruitfulness. No overfishing has left them barren. No mills have polluted their primeval purity. No railroads have frightened the salmon away from them. No mining has disturbed their native spawning grounds. As salmon rivers they are still in their original glory. To quote a not inappropriate line of Byron, "Such as Creation's dawn beheld" them, they are rolling now. Consequently nothing need be done nor any expense incurred in putting the rivers in order for asylums of refuge for the salmon.

3. No complications now exist or can come up in future, in regard to land titles in this island. The United States Government owns the land already like the rest of Alaska, by direct purchase from Russia, and has never parted with any of its exclusive rights of ownership. No State or Territory, or company or individual owns an acre of it. Consequently the U. S. Government can set aside the island for any purpose whatever, without interfering with any prior rights or titles, or incurring any risk of litigation.* Alaska is already one great reservation.

4. The island will probably never be wanted for any thing else. The summer season is so short that no crops can be raised there, and it is not likely that for many generations, if ever, the land will be wanted by permanent settlers, and it is now inhabited only by a few Aleuts and half breed families who would not be interfered with. There would be no injustice done to individuals by making a reservation of the island.

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* There are two canneries operating in the southern part of the island, but there would probably not be great difficulty in making satisfactory arrangements with them.

5. Last but not least, artificial hatching can be instituted there at any time, if it is ever thought best, and on a vast scale if desired; and unlimited numbers of the eggs of the various kinds of salmon noted above, can be obtained for distribution and sent to all other parts of the country where they may be needed.

The above considerations seem to indicate that Afognak Island possesses all the qualification required for a place of safety for our Pacific Ocean salmon without presenting any objections to its being reserved by the Federal Government for salmon, or in other words, converted into a National Salmon Park.

The writer, however, would not urge the claims of Afognak or any other place to this distinction as against those of any locality that may be found to be better fitted for it. This island has been brought forward merely as showing that one place at least is known that would answer the purposes of a salmon park. There are doubtless others in our Alaskan possessions. There are possibly better ones. If a better place can be found, let us take it. If not, let us take Afognak Island; but at all events let some place be selected and set aside by the authority of the National Government. If not Afognak Island, let it be some other place. Provide some refuge for the salmon, and provide it quickly, before complications arise which may make it impracticable, or at least very difficult. Now is the time. Delays are dangerous. Some unforeseen difficulties may come up which we do not dream of now, any more than we did a few years ago of logging on the Clackamas, or railroad building on the upper Sacramento.

If we procrastinate and put off our rescuing mission too long, it may be too late to do any good. After the rivers are ruined and the salmon are gone they cannot be reclaimed. Exaggerated as the statement seems, it is nevertheless true that all the power of the United States cannot restore the salmon to the rivers after the work of

destruction has been completed. The familiar nursery rhyme about the egg applies here with peculiar fitness:

"Humpty Dumpty sat on a wall,
Humpty Dumpty had a great fall.
All the king's horses and all the king's men
Could not set Humpty as before."

That is the whole thing, so to speak, in an eggshell. After the salmon rivers are ruined all the king's horses and all the king's men, that is to say, all the power of the government, "cannot set them as before."

Let us act then at once and try to do something for the salmon before it is too late. Dangerous complications may come suddenly upon us which we cannot foresee. How little we foresaw the danger to the buffalo and the fur seals. How suddenly the disastrous results came. Even if not impracticable it may cost large sums of money to do hereafter what may be done now for nothing. No expense may be incurred at present. All that is required is to have Afognak Island or some other suitable place set aside by national authority as Gen. Grant set aside the McCloud River Reservation during his administration, and it can be left to further events to decide whether it is expedient to expend any money on the reservation, a subject that can be safely left, we all know, in the hands of our efficient Commissioner of Fish and Fisheries. There seems to be no impropriety in the United States having a national salmon park, but on the contrary it appears eminently proper that a great natural salmon country like ours should have set apart some safe repository and fruitful breeding grounds for this noble fish.

Consider for a moment what the salmon has done for us, and then think how mercilessly we have treated him. Our salmon has been to us a source of national revenue, enjoyment and pride, and what return have we meted out to him? He has been hunted pitilessly with hooks and spears, with all kinds of nets and pounds, with wheels and guns and dynamite, and there is not a cubic foot of

water in the whole country where he can rest in safety. The moment he comes in from the ocean he meets the gill nets and the pounds at the mouth of the river, the sweep seines further up, and hook everywhere, and at last on his breeding grounds, which at least ought to be sacred to him, he encounters the pitchforks of the white man and the spears of the Indian.

Let us now at the eleventh hour, take pity on our long-persecuted salmon and do him the poor and tardy justice of giving him, in our broad land that he has done so much for, one place where he can come and go unmolested and where he can rest in safety.

Allow me to add in closing that it seems to me highly appropriate that this society, which represents with such intelligence and ability all the fishing interests of every kind in this country, should take the initiative in a matter in which those interests are so closely concerned. The writer trusts that it will, and ventures to predict that, if its efforts in that direction should happily be rewarded by the creation of a national salmon park, it would become an enduring monument to the usefulness of the Society that would last as long as the Nation lasts.

EARLY HISTORY OF THE FISHERIES ON THE GREAT LAKES.

By Herschel Whitaker.

Stretching away to the northward from the low Laurentian hills of New York to the trap-rock cliffs of Minnesota, for a distance of sixteen hundred miles, in a hydrographic basin embracing an area of one hundred and seventy-five thousand square miles, lie the Great Lakes of the Northwest, the largest bodies of fresh water upon the globe. Upon their bosoms float vast fleets which carry the rich products of prairie, forest and mine, while from their depths the fisherman gathers the rich bounties that nature has provided for the sustenance of man.

The vessels which constantly pass and repass are not freighted with ores from the mines of Golconda nor with spices from Far Cathay, but carry lumber from Saginaw, iron from Escanaba, copper from Hancock, grain from Duluth, provisions from Chicago, and cereals from the vast prairie lands of the Dakotas.

Since the early days of the French occupation of the Northwest, when the lilies of France waved over all the territory lying north of the St. Lawrence and Ohio and west of the Alleghanies, these lakes have been the great highway of intercommunication between the East and West. The Jesuit missionary filled with holy zeal departed from Montreal, the seat of French power in America, in his bark canoe, manned by his Indian converts, for the trackless wilds of the far West to raise the cross and establish his feeble mission among savage tribes.

Following him came the fur trader with his canoe and *courrier du bois*, who day after day traversed these lakes and their connecting rivers to reach some specially designated place where he might exchange his tawdry

gewgaws, beads and cheap merchandise with the Indian for the valuable skins of beaver and otter.

The cavalier, explorer and adventurer traveled over their trackless wastes of water, enduring hardship and fatigue, living upon the bounties of nature, pushing his way to what he hoped would be a discovery of a path to the Indies, fortune and fame. Each of these in his own way has left testimony of the bountiful way in which nature has stocked these waters with desirable food, and the belief of all concurred that there was an unfailing supply for man for all time, to be had for the taking.

The habits of the tribes bordering these lakes whose main reliance for food was upon the fishes that inhabited them, had caused them to resort to certain favorable localities upon the lakes at the proper season of the year to take fish for present wants and for future use. In time these points became their chief dwelling places for the greater portion of the year, and with the advent of the fur trader they became the principal places of barter.

Such localities as the Straits of Mackinaw, Sault Ste. Marie, Green Bay, Chequamegon, Detroit and Chicago became thus early known, and the history of these places as told by the early traveler shows that nature seemed to have lavished her bounties upon aboriginal man in the stocking of her waters with the most edible of fishes to provide for his wants.

Let us call a few of the earlier voyagers to give their testimony upon the abundance of fish in these waters.

Hennepin says in his Travels in 1675: "There is a very abundant fishery of several kinds of fish at the mouth of the Niagara River, among which is the whitefish, admirably good, with which you might supply one of the best cities of Europe.

"At Mackinaw the Griffin lay in the harbor amid one hundred and twenty canoes going and coming from

taking the whitefish, which the Indians catch in nets in from fifteen to twenty fathoms of water, and without which they could not subsist at all.

"At the Sault the Indians subsist by hunting stags, moose or elk and some beaver, and by the whitefish which is very good and is found in great abundance, but this fish is very difficult to take to all but these Indians, who are trained to it from childhood."

He says, on his return from his first voyage up the lakes, and after the loss of the Griffin: "On reaching Lake Conti (Lake Erie) near the mouth of the Detroit River, the soldiers who were in canoes killed with their swords and with their axes more than thirty sturgeons which came to spawn on the banks of the lake."

Charlevoix, in his voyage to North America, 1721, in speaking of Lake St. Clair, the smallest lake of the chain which lies between Lake Erie and Lake Huron: "The islands in the river seemed placed on purpose for the pleasure of the prospect, and the river and the lake abound in fish. Were it not for the Hurons at Detroit the other tribes of Indians would starve. This is in the flat lands thereabout which would furnish them sufficient subsistence though it were cultivated ever so little, but they can subsist upon the fish of the river which are plentiful. We entered the Lake Huron where we soon had the pleasure of fishing for sturgeon."

Speaking of Lake Superior, he said: "The Indians from gratitude for the plentiful fish with which this lake supplies them, and from the respect which its vast extent inspires, have made a sort of divinity of it." Speaking of Michillimackinas, he says: "The Indians live entirely by fishing, and there is perhaps no place in the world where they are in greater plenty. The most common sort of fish in the three lakes which discharge themselves into these straights are the herring, the carp, the goldfish, the pike, the sturgeon, the attikumaig or whitefish, and especially the trout. There are three sorts of these

taken, among which is one of monstrous size, and in so great quantities that the Indian with his spear will strike to the number of fifty sometimes in the space of three hours, but the most famous of all is the whitefish, and nothing of the fish kind can exceed it."

In speaking of his trip from Mackinaw to Green Bay, he says: "We coasted the north shore of the Straits of Mackinaw and finally came to the Manistique River, which is a beautiful stream abounding in fish, especially the sturgeon."

Captain John Carver, of the Provincial troops of America, in his three years' travels throughout the interior parts of North America, says: "Lake Superior abounds with a variety of fish. The principal and best are the trout and sturgeon, which may be caught at all times in the season in the greatest abundance. The trout in general weigh about twelve pounds, but some are caught that exceed fifty. Besides this a species of whitefish is taken in great quantities here that resemble a shad in their shape, but they are rather thicker and less bony. They are about four pounds each in weight and are of a delicious taste. The best way of catching this fish is with a net, but the trout might be taken at all times with the hook. There are likewise many sorts of smaller fish in great plenty here, and which may be taken with ease. Among these is a sort resembling the herring that are generally made use of as a bait for the trout."

Speaking of the falls of Ste. Marie, he says: "Nature has formed a most commodious station for catching the fish which are to be found here in immense quantities. Persons standing on the rocks that are adjacent to it may take with dipping nets about the months of September and October, the whitefish before mentioned at that season, together with several other species. They crowd up to this spot in such amazing shoals that enough may be taken to supply, when properly cured, those inhabitants

throughout the year. The fish of Lake Huron are much the same as those in Lake Superior."

Carver arrived at Mackinaw at the beginning of November, 1767, after having been to the Mississippi River and up that stream as far as the Falls of St. Anthony. He says: "We passed the winter very pleasantly at the Straits of Mackinaw. One of their amusements at this time was to fish through the ice for trout. Though the Straits were covered with ice we found means to make holes through it, and letting down a strong line fifteen yards in length to which we fixed three or four hooks baited with the small fish before described, we frequently caught two at a time of forty pounds weight each, but the common size is from ten to twenty pounds. The method of preserving them during the three months the winter generally lasts, is by hanging them up in the air, and in one night they will be frozen so hard that they will keep as well as though they were cured by salt."

This may properly be considered as the first authentic notice of preserving fish by the freezing process, and while it is crude it still was as effective as the work now done by the immense freezers found in almost every important town on the lakes.

George Heriot, Deputy Postmaster General of British North America, in his book of travels, published in 1807, says of Mackinaw that the Indians of that locality "catch herring, whitefish and trout, the trout being from four to five feet in length, some of which are seventy pounds in weight. This fish is bred in Lake Michigan and is known by the name of Mackinaw trout, and affords a most delicious food." Of Green Bay he says: "There is a village composed of natives at the mouth of this river who employ themselves in fishing."

At the Sault Ste. Marie, "At the bottom of the rapids and among their billows which foam with ceaseless impetuosity, innumerable quantities of excellent fish may be taken from the spring until winter. The species

which is found in great abundance is denominated by the savages attikumaig or whitefish. The Mackinaw trout and pickerel are likewise caught here. These afford a principal means of subsistence to a number of the native tribes."

He also speaks of the method of taking the whitefish at this place in the rapids at the foot of the falls, which, singularly enough, is followed by the Indians to this day, and from its peculiarity deserves special mention. I give his own words:

"No small degree of address as well as strength is employed by these savages in catching these fish. They stand in an erect attitude in a birch canoe, and even amid the billows they push with force to the bottom of the waters a long pole, at the end of which is fixed a hoop with a net in the form of a bag, into which the fish is constrained to enter. They watch it with the eye when it glides among the rocks, quickly ensnaring it and dragging it into the canoe. In conducting this fishing much practice is required, as an inexperienced person may, by the efforts which he is obliged to make, overset the canoe and inevitably perish. The convenience of having fish in such abundance attracts to this situation during the summer several neighboring tribes, who are all of an erratic disposition and too indolent for the toils of husbandry. They therefore support themselves by the chase in winter and by fishing in the summer.

"The Otter Nation inhabit the rocky caverns on Lake Huron, where they are sheltered by a labyrinth of islands and capes. They subsist on Indian corn and fish and the proceeds of the chase. While the women and children collect berries the men are occupied in darting sturgeon."

Mr. Henry R. Schoolcraft from the time of the establishment of the military post at Sault Ste. Marie, was the United States Indian Agent at this point. He was a man of culture and literary ability, and one of the most pro-

lific contributors to the literature concerning the habits, characteristics and language of the North American Indians. He says of the whitefishing at the Sault in 1820:

"No place in America has been so justly celebrated as a locality for taking this really fine and delicate fish as St. Marie's Falls. This fish resorts here in great numbers, and is in season after the autumnal equinox, and continued so until the ice begins to run. It is worthy the attention of ichthyologists. It is a remarkable but not singular fact in its natural history, that it is perpetually found in the attitude of ascending at these falls. It is taken only in the swift water at the foot of the last leap or descent. Into this swift water the Indians push their canoes. It requires great skill and dexterity for this. The fishing canoe is of small size and is steered by the man in the stern. The fisherman takes his stand in the bow, sometimes bestriding the vessel, having a scap net in his hand. This net is made of strong twine, open at the top like an entomologist's. When the canoe has been run into the uppermost rapids and a school of fish is seen below or alongside, he dextrously puts down his net and having swooped upon a number of fish, instantly reverses it in the water, whips it up and discharges its contents into the conoe. This he repeats until the canoe is loaded, when he shoots out of the tail of the rapids and makes for the shore. The fish will average three pounds, but individuals are sometimes taken two or three times that weight. It is a great resource of the Indians and of the French, and of the poor generally at these falls who eat it with never-ceasing appetite. It is also a standing dish with all."

Listen to his tribute to the edible character of the whitefish:

All friends to good living by tureen or dish,
Concur in exalting this prince of a fish,
So fine in a platter, so tempting a fry,
So rich in a gridiron, so sweet in a pie,
That even before it the salmon must fail,
And that luscious *bonne bouche* of the land beaver's tail.

* * * * *

'Tis a morsel alike for the gourmand or faster,
While white as a tablet of pure alabaster,
Its beauty or flavor no person can doubt
When seen in the water or tasted without,
And all the dispute that opinion ere makes,
Of this king of lake fishes, this "deer of the lakes,"
Regard not its choiceness to ponder or sup,
But the best mode of dressing and serving it up.

Sheldon, Disturnell, Strickland, Kohl, Hubbard and others all unite in saying that nature here seems to have lavished her bounties with no niggardly hand, so profusely are these lakes stocked with fish.

From the time of the discovery of the lakes down to the time of the establishment of the Hudson Bay Fur Company, these inexhaustible supplies were drawn upon only for the subsistence of the Indian tribes and the voyagers, but gradually they became, to a small extent, an article of commerce, the surplus being saited and sold in somewhat inconsiderate quantities. During all this time the northwestern territory was looked upon as a source from which valuable furs could be obtained, and but little attention was paid to the fisheries of the Great Lakes beyond what the immediate wants of those who lived upon them or near them demanded.

Little is known at the early time of which I speak with reference to the fisheries of Lake Erie, because of its situation it was but little frequented by the early explorers and fur-traders. Good reason existed for this condition of affairs. The blood-thirsty and cruel Iroquois, the most adventurous and warlike Indian tribe which ever inhabited the continent, held undisputed possession of all that wilderness lying about Lakes Ontario and Erie and adjacent to the Niagara River, which was a key of approach to the latter lake.

The rivalry between the Dutch fur-traders of New York and those of the French was exceedingly intense in their attempts to control the fur trade of the Northwest. The Iroquois were incited by the Dutch to throw every obstacle possible in the way of encroaching advances by the French traders and colonists. For many years the Iroquois, who by reason of their situation acted as intermediaries between the further western tribes of Indians, controlling in their own interests the fur trade between the Dutch and these tribes, fiercely resented all attempts at interference in this trade by the French. As a result of their attitude the great waterway communication between Montreal, the seat of the French fur trade, and the Great Northwestern lakes was closed by the Iroquois, and communication with the upper lakes was made by way of the Ottawa and the French Rivers into Georgian Bay and from thence into lakes Huron, Michigan and Superior.

Meagre, however, as the information is that we have concerning the condition of the fisheries on Lake Erie at this early period, such information as we have shows beyond question that fish were exceedingly plentiful, especially at the Put-in-Bay Islands and Sandusky Bay. Dr. McCallum of Dunville, Ontario, at a meeting of the International Fish Conference, held at Hamilton last winter, exhibited to the meeting two crude shellfish hooks which were found on Point au Pelee, in the Province of Ontario on the North Shore of Lake Erie. These hooks were presumably made from the shell of the freshwater mussel. In appearance they resemble the rude hooks employed for taking fish by the Esquimaux and other aboriginal types. The shank and the point were in two separate pieces, having holes drilled through them by which they could be attached to each other with thongs, the hook itself being barbless. Their form and construction indicated plainly that if the aboriginal man was compelled to sustain life by means of fish taken

with such an implement, the fish must have been exceedingly plentiful in this lake. Facts at hand would seem to indicate that Lake Erie was in these early days bountifully stocked with fish, and although it has been fished constantly for a very long period, it still yields immense quantities of valuable commercial fish.

Blois, speaking of the condition of the fisheries as early as 1835, in his "Gazeteer of Michigan," says: "Their quantities are surprising, and apparently so inexhaustible as to warrant the belief that were a population of millions to inhabit the lake shores they would furnish ample supplies of this article of food without any sensible diminution."

Looking at the matter from that period of time the writer was unquestionably warranted in his assumption. But Blois could not have apprehended at that time that the census of 1890 would show that in the six States surrounding the Great Lakes there was a population constituting more than one-sixth of the entire population of the country. Neither could he anticipate that the methods of preserving fish would, within thirty years from the date of this writing, make it not only possible but profitable for fishermen to follow their calling almost continuously during the entire year.

Michigan statistics show that in 1830 the quantity of fish marketed in the State amounted to 8,000 barrels valued at $40,000.

In 1836 the whole number of barrels taken amounted to 11,400.

In 1837, to 13,500 barrels of the value of $125,800. Of this quantity one-fourth was consumed in the State and the rest was shipped to Ohio, New York and Pennsylvania.

It will be observed that the reports of the catch and value of the commercial fish upon the Great Lakes are somewhat meagre and desultory. The report of the Detroit Board of Trade for 1857 shows that there

were between 80,000 and 100,000 barrels of fish taken in that year, valued at $640,000.

In 1885 the reports gathered by the Michigan State Board of Fish Commissioners show that the value of the commercial fish taken in the State was in value about $1,500,000 at wholesale price.

In considering such statistics as we have, we must take into account the uncertainty and unreliability that must necessarily prevail in their collection because of the want of thoroughness and completeness with which the work was done in the earlier years. So, too, we must consider in comparing one year with another the varying conditions of seasons, which is a potent factor. Severe storms may prevail one year, while the next year may be an exceedingly favorable one, and, therefore, their reliability is much impaired and the basis upon which we must make comparisons is at best unsatisfactory.

Causes of Decay.

Until about the year 1852 the fishing industry on the lakes was prosecuted almost entirely with gill-nets. Since then the gill-net fishing has continually increased until now the length of the gill-nets fished in Michigan waters alone, according to the last reliable statistics within our reach, amounts to 1,725 miles.

About the year 1850 the pound or trap-net was introduced into the Great Lakes. Its use conclusively shows that it has been one of the most destructive of fishing devices, and is responsible for the great decay of the fisheries which has been observable during the last twenty years.

Concerning the introduction of the pound-net into the Great Lakes, I am indebted to Mr. L. Anthony of Sandusky, O., for the following facts:

Pound-net fishing was first introduced by Messrs. Spencer and Courtland, two Connecticut men, at Sandusky, O., in the year 1850. The fishing with these nets

was at first done in shoal water in the bays and rivers in a depth of about 10 or 12 feet.

In 1852 Mr. L. Anthony of Sandusky, in the fall of that year began fishing with small bay nets, which was the first attempt. This fishing was done at Locust Point, between Toledo, O., and Port Clinton, Ottawa County, in the same State, in a depth of 9 feet of water. The fish were plentiful and the catch was remarkably large. He salted fifteen hundred half barrels of whitefish during this season, besides selling large quantities to the farmers, who came to the fisheries from long distances.

In the fall of 1854, Mr. Spencer, the gentleman formerly alluded to, together with other parties, including Mr. Anthony, conceived the idea that this plan of fishing could be successfully done in the deeper waters of the lakes. The first attempts was made by Mr. Anthony of deep water pound-net fishing, in the spring of 1855, at Kelly's Island and Put-in-Bay, in Lake Erie, Ohio, with marked success.

In the year 1854 he did his first pound-net fishing in Lake Huron at North Thunder Bay, fishing in 33 feet of water; fish were caught here in large quantities. There has also been some small fishing done near Lexington, Mich., which was not successful.

In the year 1856 Charles Ruggles and Capt. James Bennett fished with deep water pound-nets in Hammond's Bay, on the south shore of Lake Huron, and also on the north shore of Lake Michigan. At that time this was the largest and most successful fishery in the whole country. At the Thunder Bay fishery, on Lake Huron, Mr. Anthony caught in one net in twenty-four hours, four hundred of half barrels of whitefish. There were not one hundred pounds of other varieties caught on this occasion.

In 1865 he commenced fishing with deep water pound-nets at the Apostle Island, Madeline Island, Presque Isle, and Sand Island in Ashland Bay, off Bayfied Point,

in Lake Superior, and these fisheries resulted in a profitable investment.

From this date on the pound-net fishing increased beyond all conception. It is not infrequently the case that pound-nets are set in gangs reaching out from the shore a distance of three or or four or more miles, and the destruction of fish by this method of fishing is immense. Unquestionably the fish so taken are superior to fish taken by the gill-nets because they are preserved alive until the nets are raised, but it takes everything, great and small.

No fishculturist should condemn the taking of fish if the fishing were done with judgment and with a due regard for the future.

The iniquitous feature of the business is that the cupidity of the fisherman overcomes his better judgment, and he takes from the water large numbers of small and immature fish that are of little or no value as merchantable fish. The result of this system of fishing is most destructive, tons upon tons of fish being thus taken which have never spawned, whereas if they were permitted to remain in the water to reproduce their kind, artificial methods would be greatly aided.

About the year 1868, Mr. William Davis of Detroit, patented a freezing apparatus for the preservation of fish. In that year about sixty tons were frozen in Detroit, and seventy-five tons in Toledo. This method of preserving fish was not very kindly received at first, but gradually grew in favor. Previous to this time, during favorable seasons, large quantities of fish were taken over and above the needs of present consumption, and the only means of preserving them was by the salting process, which considerably reduced their value. Gradually the freezing process grew in favor, and it was found by experience that fish might be frozen and held in that condition for any length of time. The result has been that in almost every important town upon the lakes

which is the seat of a fishing industry, there are to-day one or more freezers with varying capacities, most of which are exceedingly large. Their erection has given a great impetus to the fishing industry. While formerly the lake fishing was prosecuted mainly in the spawning season, the methods of fishing have so changed by reason of the opportunity afforded by the freezer system of holding the fish for any length of time that now and for a number of years past fishing has been carried on in nearly every month of the year, and is only interfered with by the rigor of the season when nature closes the waters for perhaps a month or so.

Reliable statistics furnished show that the following quantities of fish were frozen from 1869 to 1884: In 1869, 400 tons; 1871, 600 tons; in 1872, 600 tons; in 1873, 700 tons; in 1874, 600 tons; in 1875, 800 tons; in 1876, 1,100 tons; in 1877, 1,200 tons; in 1878, 900 tons; in 1879, 1,100 tons; in 1880, 700 tons; in 1881, 1,100 tons; in 1882, 1,300 tons; in 1883, 1,450 tons; in 1884, 1,600 tons.

No information is at hand for the seven years from 1884 to 1892, during which years it is fair to be presumed from the general knowledge we have on the subject, these amounts were very largely increased.

The average number of tons per year for the fifteen years amounts to 1,000 tons. Averaging these fish at 2½ pounds weight apiece, the number of fish caught on an average for each year and frozen would be 800,000, and for the entire period of fifteen years it would amount to 12,000,000 fish. This takes into consideration only the fish that were frozen, and my opinion is, that if there is any error in the above figures, they are much below the actual amount. But by far the greater quantity of fish taken are sent to market, iced, fresh, but not frozen. I believe it is within reason to say that the frozen fish will not represent more than one-fifth of the total quantity taken.

When we consider this large number of fish which are being constantly taken from these lakes, we can better appreciate the serious inroads which are being made upon the supply; and when we add to this the wanton destruction of millions of small and immature fish taken that are never given an opportunity to spawn, and when we further consider the large number of gravid females, the roe of which is lost by this capture, we can begin to appreciate the problem that is set before fishculturists to restore this great loss.

MEANS OF ARREST OF WASTE AND RESTORATION.

If the wealth of the waters of the Great Lakes is to be maintained, nothing can be clearer than that this great waste, which has been going on for more than a hundred years and is increasing, must be arrested. There are two methods by which this may be effected:

1. By a liberal and lavish stocking of the waters.
2. By the enforcement of just protective laws preventing the taking and marketing of unmerchantable, young and immature fish.

As to the first point each State must act for itself in protecting its own interests in the fisheries. Weak and erratic efforts made now and then to make good the loss by the planting of a few million fish will not do. With the means at hand and with the information we now have as to fishculture, and with the small outlay of money necessary to carry on the work of artificial propagation, each State should see for itself that every female fish taken during the spawning season in its waters shall have her eggs taken from her, fecundated and after being hatched, properly planted; there is no good reason why this should not be done, and if the States whose interests are involved will take immediate steps to carry out this line of policy, they will have taken a step in the proper direction for the maintenance of their fisheries.

As to protective laws, let me say this: No laws should

be passed which should rob the fishermen of the right to follow his calling within legitimate means. If our work means anything it means that we are engaged in an undertaking which, if properly conducted, will result in a direct benefit to the fishermen and incidentally in great benefit to the people at large in the maintenance of a cheap and wholesome food. With this understanding of the conditions, fishermen should be willing to submit to such just and necessary laws as may be required to prevent destruction of young fish which are of no special value for their purposes, and the destruction of which means the ultimate decadence and extinction of their means of livelihood. So far as uniformity in laws can be secured regulating the fishing in the different States, they should be made uniform, but experience seems to indicate that the fault lies not in the number or effectiveness of statutes, but in the inadequacy of the means which have been used to enforce them.

Most of these laws are inherently defective because of the attempt to build up a warden system by counties, allowing the compensation of wardens to be fixed by the boards of supervisors, who, as a rule, will grant no compensation, or one which is grossly inadequate, which results in making the warden system of no effect. New York has without doubt the best warden law of any State in the Union, because the pay of her wardens is sure and fixed.

The ideal law would be one giving authority to the Board of Commissioners of each State to appoint a chief warden with such deputies as he might require for a proper enforcement of the laws, whose compensation should be sufficient to secure the services of good men who should be paid by the State. The State might be districted, but in that event each warden could exercise the functions of his office in some district other than the one in which he resides, thereby removing from local influence in the administration of his duty.

The States should make and enforce their own laws. No other power can do it so effectually and well. Their legislatures are familiar with the necessities of their States, are quick to respond to the wants of different localities, and by frequent contact with their constituencies know their wants.

If a general awakening of the lake States can be had as to the necessity of proper action to maintain their fisheries as above suggested, there is no reason why the great food supply furnished by these waters may not be maintained at least in their present value, with a hope of future increase.

IMPREGNATING EGGS OF THE RAINBOW TROUT.

By Wm. F. Page.

The object of this paper is to bring to the notice of this Society, and through it to the notice of fishculturists in general, a subject which has not received that degree of attention its importance would warrant; the wish is to arouse interest sufficient to lead to a correct and, if possible, a practical solution of the difficulty of impregnating the eggs of the rainbow trout.

On page 819 of the report of the U. S. Commission of Fish and Fisheries for 1882, under the report of Mr. Frank N. Clark, is the earliest record of a peculiar incident occurring in the work of impregnating the eggs of the rainbow trout. This peculiarity can not be better described than by quoting Mr. Clark's report;

"Our facilities being first-class and having been uniformly successful in the propagation of trout, not excepting the preliminary experiments with rainbow trout for four seasons, I had confidently expected to embryonize from one to two hundred thousand eggs from the stock of *irideus* hatched and grown at this station; but we succeeded in getting only 45,000 eggs (many of the

"females failing to mature their spawn) and in fertilizing "but 15 per cent of these, resulting in a hatch of 6,400 "fish. The parent fish, of both sexes, were and still are "perfectly normal, so far as conduct and appearances "would indicate. The trouble, however, seems to have "been entirely with the females, as the quantity and "quality of the male principal was all that could be "desired. Whatever the cause of the difficulty, the effect "was at once apparent in the abnormal character of the "fluid surrounding the eggs. From most of the females "the eggs would fall into the receiving pan like shot, "accompanied by one half to one fluid ounce of watery "substance, sufficient of which had been absorbed to "prevent fertilization. If there was any doubt that "absorption of water by a large percentage of the eggs "had taken place before leaving the fish, it was dispelled "by the fact that it was quite full and hard when taken "and refused afterwards to take up any more water. "Moreover, the eggs from six females were found to be "enveloped in the natural viscous fluid, and these were "successfully fecundated."

The record above set forth refers to the spring work of 1883 at the Northville Station of the U. S. Fish Commission. Succeeding reports from this station, including the season of 1888 give varying degrees of success; ranging from 15 per cent. to 69 per cent. and averaging but 39 per cent. of impregnation during a period of six years.

When we consider the large experience and high degree of success attained by Mr. Clark as a fishculturist, we cannot help but be struck most forcibly by the seeming failure of this branch of work at Northville. But, the report quoted by Mr. Clark shows us where to search for the cause. It is to be found in those hard, distented eggs which fall into the receiving pan like shot, and are frequently accompanied by an abnormal fluid. If this trouble were confined to the Northville Station solely, it might not be considered of sufficient importance to

bring to the attention of this Society; but it is more wide-spread and destructive in its perniciousness than is generally known or supposed. There is, in fact, just reason to believe that, during the past twelve years, there has been a loss of fully ten million rainbow trout eggs to the fishculturists of the United States. Had it been possible to impregnate these ten million eggs they would have had, all things considered, a value of $18,000 to $20,000.

Whilst the trouble has proven insurmountable in Michigan, it has been serious in New York, alarming in Arkansas, and felt in no small measure in Virginia and Missouri. In Wisconsin the hard, distended eggs are not strangers (though Mr. Nevins is able to hatch 80 per cent.) And, following it Westward, it shows its hydra head in Colorado and even in California.

In his original report of this trouble Mr. Clark says; "Without attempting to account for the failure, I am "inclined to think that the fish were overfed, and that "the in-flow in their pond gave them a current quite too "slow and feeble, resulting for the most part, in great "inactivity and in their being in good condition for "market at spawning time. I propose to reduce their food "allowance to a minimum and place them in a good current "of water." Future reports do not show that these remedies were tried, though it is fair to presume they were. But, in the United States Fish Commission Report for 1885, page 126, this statement from Mr. Clark occurs; "It would seem that the species (*irideus*) will not acclima- "tize to the waters of this station (Northville, Michigan)."

These views of Mr. Clark are here given to call to your attention the theories which have been advanced and partially tried. Based on data which will follow, I believe the first two theories, "over feeding" and "insufficient current," to be erroneous.

Messrs. Annin, at Caledonia, New York; Monroe Green, at Mumford, New York; Mather, at Cold Spring

Harbor, New York; Dean, at Leadville, Colorado; Robinson, at Mammoth Spring Arkansas; and Fitzpatrick, at Chabot Lake, California; in common with Mr. Clark, at Northville, Michigan, have not averaged above 50 per cent of impregnation with the rainbow trout eggs. Mr. Seagle, of Witheville, Virginia, concedes 20 per cent. of his average take to be "hard, glassy eggs," and Mr. Nevin, of Madison, Wisconsin, acknowledges "we get a number of hard, glassy eggs." At Neosho Station, during the season just passed, 66 per cent. of our rainbow trout eggs failed to fertilize. In the transactions of the last meeting of this Society, Mr. Seal is recorded as saying: "I find that in Mexico they appear to accom-"plish more with the rainbow trout than we do here." With reference to this particular work Mr. E. Chazari writes me from the City of Mexico, under date of April 26th, 1892; "Mr. Clark's difficulty occurs among us also " * * Taking approximately the average we "have had this year 50 per cent. of the eggs borned "(spawned) sickly or bad, and at the end of the incuba-"tion, a total loss of 80 per cent." This is the result of four year old trout under domestication in Mexico. Summarizing the statements from these different sources, I am forced to the conclusion that of the whole number of rainbow trout eggs artificially spawned from domesticated fish, less than 50 per cent. are impregnated because of the impotency of the eggs to receive the fertilizing principle. At some places, in some seasons, the percentage will run higher; whilst, as has been shown, on other occasions it will fall much lower. This average of 50 per cent. is based on the work of ten hatcheries in eight states, embracing all the climatological and hydrographical conditions of the United States, except the far south, and may be modified by the accession of additional information. But I feel pretty sure, that upon fuller investigation, the statement will be confirmed rather than disproved.

During the season just passed, when studying this matter, it seemed to me unreasonable to suppose that at all of these stations an error had been made as to the proper feeding and watering of the parent stock of trout. Therefore I have discarded the theory first advanced by Mr. Clark, and began to cast about for some other ground.

During January, 1892, Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries, at my earnest request sent Prof. Chas. Edw. Riley, of Drury College, Springfield, Missouri, to the Neosho Station to make a microscopic examination of the eggs and milt at the time of their extrusion. Prof. Riley made several examinations of the hard, glassy eggs, and also of the accompanying abnormal fluid. By the aid of the highest power lenses he discovered a tape-worm-like parasite in the hard eggs, and also in the accompanying abnormal fluid. No parasites whatever were found in any of the normal eggs, either dead or alive. He concludes his report of this investigation in these words; "From a careful considera-"tion of these facts I should say that some parasite had "infested the trout. It breeds on this peculiar fluid "before described, and is absorbed with the fluid before "spawning; thus causing the eggs to swell up and sound "hard when they strike the pan. I am strengthened in "this belief since apparantly the same thing was found "in the 'peculiar fluid,' in the eggs and in the water "after passing over the eggs, while the water at the supply "pipe was practically pure. I can not name the parasite, "or account for its presence."

Later in the season a series of eggs, normal and abnormal, was carefully prepared and forwarded to Prof. Riley, at Springfield, for further examination. Under date of March 24th, 1892, he wrote; "I have care-"fully examined these specimens, and in each case simply "corroborated what I found at Neosho."

Another series of specimens preserved at the same was forwarded to Washington. D. C., but unfortunately,

was so long delayed before reaching Dr. Gurley of the U. S. Fish Commission, as to be, in most cases, in an advanced state of decomposition and unserviceable for examination.

Awhile back I stated that the hard, shot-like eggs and accompanying fluid were the cause of the imperfect impregnation; but if Prof. Riley is correct, they are but an effect and the true cause is yet deeper. A study of these parasites with a view of their possible elimination opens a field which but few if any, fishculturists are prepared to tread. If further investigation confirms the impression that these parasites are present, and that to their presence is due the loss of one-half of the possible efficiency of our work with the *irideus*, we have a serious and delicate problem, one which probably only the skilled bacteriologist can handle.

Dr. Gurley has happily suggested that a simple, though heroic, cure may be found in the progressive elimination of those females producing abnormal eggs. The only practical solution may yet be found to lie in this direction. In the meantime, it would be of value if any of our spawn takers could positively state that the female rainbow trout which yield normal eggs in one season do not yield the abnormal, hard eggs in subsequent seasons. The converse of this proposition would be of equal value.

It has been suggested as a possible solution of this difficulty, that it arises from inflammation of the ovaries, established by improper and rough handling at the time of artificial spawning. From my own experience I can state that, though this suggestion may be true in some isolated cases, it is scarcely applicable to the case in general.

At the Neosho Station during the season of 1891-'92 we spawned one thousand twenty months old *irideus*. Many of the females, when handled for the very first time, readily gave down these hard, shot-like eggs without the least pressure, showing conclusively to my mind, at least

that inflammation of the ovaries, if existing, had not been occasioned by improper handling. I might here state that it is poor workmanship to use any pressure on the abdomen of a trout in taking eggs. If the fish be ripe, and she is held in proper position, she will, by her own exertion, extrude her eggs. It is true that a gentle assistance will sometimes be necessary to enable her to pass the eggs from the anterior portion of the ovary to the vent; but the exercise of enough pressure to occasion inflammation would be inexcusable. Such an amount of pressure may be; and is employed on fish caught and destined for immediate marketing, such as shad, whitefish, etc.; and, again, it is unreasonable to suppose that the exercise of pressure at one spawning sufficient to occasion inflammation of the ovaries would not result in the death of the female before the occurrence of another spawning period? Or, if not in her death, at least is such a disorded condition as would be indicated by some outward sympton?

After reading the report of Prof. Riley, as above set forth, as to the presence of parasites, I thought that they, the parasites, might have been introduced into the domesticated rainbow trout by the use of beef liver, the almost universal fish food, somewhat in the way that trichina are introduced into the human system by the use of raw pork. Working in a preliminary, amateur fashion along this line, I addressed a number of letters to prominent fish culturists, asking if they cooked the liver or used it raw. Some used raw liver; others, a mixture of raw and cooked liver; and others, a mixture of raw liver and mush. But the answer which upset my theory came from my old preceptor, Mr. Fred Mather, who had experienced the trouble of hard, glassy eggs from rainbow trout which had never been fed on any beef liver raw or cooked. Following on the heels of this came a letter from M. James Richardson, Superintendent of the California State Hatchery at Sisson. His communication contained a statement of a fact of which I had never

dreamed. He says; "Yes, I have observed, to a small "extent, the hard, glassy eggs from wild trout caught "from the streams of the Pacific slope." This so far as I am able to ascertain, is the first intimation that the hard eggs are found in these fish in their native home. It is true that Mr. Richardson says that under his observation it occurs to a small extent. Mr. Richardson's statement may be taken as a further argument against the theory of inflammation being established by rough handling. But its true significance is this; the origin of this abnormality of the *irideus* is not attributable to domestication, it exists to-day among these fish in their native state, but it seems that in domesticating them we have aggravated this abnormality. That is to say; we have, in some occult manner, given prominence to the environments that increase the propagation of the parasite discovered by Prof. Riley, and which appears to exist, to a limited extent in the female trout in her native habitat; whilst on the other hand, we are omitting something which would tend to suppress its reproduction. This being true the remedy for the trouble might be found in a condition of food and life approximating those of nature. Such may not be attainable at all points. No method seems so feasible as that employed by Mr. Gemaz of France, in his ponds for the self-reproduction of natural fish food. It would, of course, be necessary in such an undertaking to stock the ponds with proper natural food from streams from the Pacific slope; for, otherwise, that particular element which tends to maintain a healthy condition of the reproductive organs of the *irideus* might be omitted.

In conclusion, I beg to quote the following significant clause Commission for 1882; "In producing and raising "helpless infancy some of the fish tribe, art may surpass "nature; but only by a return to the ways of nature at a "period when helpfulness succeeds helplessness can the "best development come."

NATIONALISM IN STATE FISHERIES.

By C. A. CHAMBERLAYNE of Massachusetts.

Mr. Chairman and Gentlemen:

It is with very justifiable hesitancy that I ventured to address this presence I am afraid that my practical knowledge of fishculture is limited to a fascinating trout brook found in that part of Massachusetts known as Cape Cod, along the banks of which some most delightful hours of my life have been spent. I must plead guilty to a dense ignorance on the subject of those ingeniously constructed but not entirely settled *latia disepuotias* of the inhabitants, depths or shallows, for which I have constantly and so far successfully relied upon a certain commissioner from the State of Maine, who is detained from you to-day by a sickness, which he greatly regrets.

But, while it will be impossible to masquerade before you as a worthy associate in any scientific aspect for the means of national definition of approved knowledge and experience gathered here, it may still be permitted to claim such brotherhood in the great guild of friendship for the fisheries or may properly be conceded to careful consideration of the fish food supply of the country, and at least partial appreciation of the importance of its preservation, and some knowledge of certain of the obvious dangers that threaten it.

It has been suggested that a word or two might properly be said of that attempt at national legislation called the "Lapham Bill." The suggestion is a flattering one, for the Lapham Bill is interesting in itself, in its history, and still more for what it represents. It is difficult to say whether it is more worthy of examination in the legal, the scientific or the political side. What the bill proposed originally to do is not disputed. It attempted to revolutionize the control of State fisheries, to nationalize them. Its purpose was, and its effect would have been, to abrogate all important fish laws of the entire

Union, whether seaboard or inland. To be sure, it applied directly but to mackerel and menhaden, but the possibility of its passage was based upon a larger general power and none of its advocates denied the fact. After the most careful examination which I have been able to give the subject, it is, in my opinion, perfectly clear that there is not the slightest foundation for the contention that, as matter of law, Congress has the power here claimed. Nothing is clearer than that within the territorial limits of a State (that is, speaking generally, within a marine league of seashore States), it is not within the powers of Congress to abrogate or contravene a State fishing law. The contention of the friends of the bill is a most contradictory tissue of half truths and non-sequiturs, frequently even relying upon verbal quibbles and more often upon failure to give due weight to qualifying principles So far as the present state of the decisions is concerned, the rights of the States have nothing to fear from the legal aspect of the Lapham Bill.

While, however, it is satisfactory to know that Congress cannot amend State law, it is equally satisfactory to remember that it is by no means powerless in the premises. While Congress cannot abrogate State law, it can supplement and aid it. Under its power of prohibiting importation and of regulating American vessels engaged in fishing outside State limits, Congress can practically enforce a close season and probably limit the effect of destructive methods of capture by removing a profitable market or by forfeiting the Government license in case of violation, by those on board, of the Act of Congress. This power is well illustrated in the passage of the Mackerel Law of 1887, now expiring by limitation.

In further exercise of its power to regulate commerce, Congress may prohibit between States the transportation of fish which would, by the laws of any State be forfeited and by the easy process of making such offense

triable in the Courts of the United States could exercise a most valuable repressive influence against the perpetration of certain offenses against the fish and game preservation with which the States are at present dealing under great disadvantage. Legally, the situation is a good one. The State can be aided in its efforts. Its local fish laws cannot be abrogated by Federal authority.

But, while there is little ominous to the interests of the fisheries in the legal aspects of the "Lapham Bill," there is more in the persistency, skill and concentration with which the bill was urged upon Congress and with which the facts calling for its passage were insisted on. It is not too much to say that the case of the petitioners was admirably handled. Through all the ramifications of influence which could act upon legislators and committeemen, apparently every useful exertion was made for the passage of this bill. It is generally believed that the effort for the passage of the bill was visible in the Speakership contest on the occasion of the organization of the present House of Representatives, and that a pledge for the bringing forward of that particular bill procured Speaker Crisp the vote in caucus of Mr. Paige of Rhode Island, if not of other members. Many circumstances tend to bear this out. Literature of different kinds, much of it bearing evident marks of a purpose, had been prepared for months and was on hand for circulation in easily available forms. Not only was the entire membership of the United States Menhaden Oil and Guano Association stirred up to intense activity, excellently led and handled by its president, who directed operations on the spot, but allied trades having similar interests were induced to respond, its treasury was emptied into the fight.

The mackerel fishermen desiring the same objects, were joined as "silent partners" in the menhaden venture, but little argument being made in their favor, but, like other silent partners, useful in a financial point of view.

The fishmarket men of New York, Boston, Philadelphia, Portland and other cities, gave most energetic co-operation.

The net and twine corporations of New York, Baltimore, Gloucester, Boston and elsewhere, were able to add to the combined attack their estimates of the importance of removing State restrictions.

The fertilizer companies using the refuse menhaden scrap for its ammonia, ranged themselves in line. These diverse organizations not only packed the committee room on the Committee on Merchant Marine and Fisheries four successive days with a crowd of shrewd, interested. highly respectable witnesses, but exerted an immense, if indirect, influence upon the Congress. Not only were these influences and many others energetically at work, but there was an appreciable amount of brains in the management and plenty of cash to back up the brains. If any particular thing was to be said, editorially, in a newspaper, it was procured at just the right time and neatly marked in blue pencil, placed before the proper person through the most effective channel. If any Board of Trade resolution or other expression of opinion would be influential with an individual member, the meeting was held, the resolutions adopted. Some one saw that it was done. If a member could not be directly approached and his "friend" could be, the friend was ready at his elbow. Able counsel, amply supplied with funds and the consequent leisure and opportunity had spent weeks in preparation and could display those little social courtesies to members, which, with a body so large and so indifferent as Congress cannot well fail to be a force in themselves. If a reasonable *douceur* was necessary to enlist the interest of local or general newspaper reporters. the money was ready. If a Fish Commissioner of Massachusetts showed energy in opposing the bill, the man supposed to be most influential with him was able to threaten him with personal and official extinction. If a Congressman showed an unduly active

interest for the fisheries, a "back fire" was immediately attempted to be kindled in his district by arousing threatened and portentious opposition to his re-election and he was of course carefully informed through papers constantly laid on his table, of progress of the flames. Such persons as were amenable to more sordid and substantial arguments were in the hands of other agents "with the necessary funds." The shreds of legal arguments in favor of the bill were skillfully dressed and padded into a semblance of plausibility, the apparent hope being that the committee, many of whom were not lawyers, might conclude that where so much could be emphatically said, there must be at least enough to warrant an opportunity for judicial decision.

On the other hand, the wellworn arguments in favor of such an act were discriminatingly adopted to the supposed taste of the gentlemen who were asked to swallow them. The "poor man's cheap food," the "note of sport," were relied on. The petty, local nature of these State regulations, conceived in ignorance and brought forth in prejudice, was incessantly dwelt on. The advantage to farmers especially in the West and South of having the cheap fertilizer made by Mr. Bradley of Boston, from the fish scrap of Messrs. Church Bros. of Tiverton, R. I., was depicted in glowing terms. Fields of waving grain and thousands of bales of of snowy cotton grew up in plain sight of the committee under the magic wand of the petitioner's eloquence, as the necessary result of destroying the fisheries of Buzzard's, Princess and Casco bays. The miner's lamp was destined to go out; coal supply cease or advance in price; the shoe manufacturer must abandon his business, people go unshod should the ponderous wheels of Congressional legislature fail to start for the benefit of the gentlemen who had banded themselves together into the "Guano Association" for they purpose, as they euphemistically phrased it, "of steadying prices."

In these and various other ways the fine hand of good, practical management showed itself. As one of their witnesses stated, "It was either a funeral or a resurrection," and they acted accordingly. Is it to be wondered that such persistent, well directed effort accomplished results? Is it strange that when the Stenographer of the Committee was in the pay of the association that the record at critical points, such, for example, as that relating to the wishes of the fish Commissioners of the United States for assuming control of State fisheries or the "trust" nature of the Guano Association, the record has itself been materially altered and masculated? Is it a matter for surprise that six Democratic members of a Democratic House of Representatives should vote for a surrender of the rights of their States and an absolute abandonment of a distinctive principle of their party; that when the committee itself stood seven to six, a Democratic speaker of the House of Representatives should "promote" a Republican member of the majority off the committee and substitute a more available man; that a substitute bill should then be introduced substantially similar, but most dangerously misleading; that the action of the committee should then be reversed by a snap judgment, only saved from final approval by the good sense of a single man; that, finally, this decision should be reversed in the utter absence of the entire elements friendly to the bill, with the singular spectacle of a Chairman who declined to vote and only attended to make a quorum?

Is it surprising that, notwithstanding an emphatic recommendation from the Governor of Massachusetts, these netting interests should by indirection for weeks, prevent sending any official representation from Massachusetts, while charges of the bribery of several members through the lobby were continually circulated? Is it to be wondered at that a Fish Commissioner of Massachusetts saw reason suddenly to leave for home and never

return; that representatives from our fishing ports like Gloucester and from fish distributing points like Portland, Boston or New York saw good cause to support the bill? It is even unintelligible that an official of the United States should allow a confidential subordinate most disingenuously testify for the greatest fish destroying agency of modern times and himself personally to endorse a bill which would have made ignorance and ambition supplant knowledge and intelligent interest in control of the great fishing interests of the States of the Union?

With this incessant, well directed, well supported work the cause of the defenders of fisheries did not invite comparison. The disadvantage under which the public interest labors compared with private interest, showed out clearly from the first in alarming contrast. There were, of course, certain Representatives in Congress who gave consistent and loyal support to the cause of fish preservation in spite of threats and at much personal inconvenience. Messrs. Milliken and Boutelle of Maine; Hoar and Randall of Massachusetts, more especially Mr. Seth Milliken, gave their personal attendance to the hearings of the Committee and every possible assistance to the representatives of the cause. Mr. W. A. Jones of Virginia made an excellent argument against the constitutionality of the bill. In other ways and through the members, undoubtedly excellent work was done. But necessarily much of such work was disconnected and without co-operation or general direction. It was done in most cases in the interests of other business by men having large matters on hand and without the benefit of special knowledge or experience. Much of it was offset by the efforts of other Congressmen like Coggswell, Paige or Lapham in favor of the bill. Necessarily such systematic work as must be done fell to other hands and these were few and not especially practiced. Really, gentlemen, it was at first disheartening, indeed.

On the occasion of the first hearing, February 17th, 1892, the friends of the bill were able to create an atmosphere of opinion in their favor, which could not but affect the judgment of the Committee. They packed the large Committee room to suffocation; they had innumerable large delegations, representing important interests from large cities; they had excellent counsel, good stenographers, and put in an apparently overwhelming case carefully elaborated with models and figures in abundance.

On the other hand, to cross examine without any previous knowledge of their testimony, these numerous and well equipped witnesses were two solitary gentlemen from Boston and New Bedford in Massachusetts. My associate, Mr. Palmer, and myself. It is obvious that the situation is absurd. Here was the most determined, well directed assaults againt the fisheries of the States of recent years, backed with an ample treasury, under good leadership, and the defence was left almost to go by default.

Well, we did the best we could. Neither of us had any official standing before the Committee. Neither of us had any compensation, present or prospective. Mr. Palmer represented a sporting association upon Buzzards Bay, and his expenses, to a limited amount, were guaranteed by that organization. I myself represented certain towns on Buzzard's Bay, through memorials signed by their official representatives, and my expenses to a limited extent were paid by private generosity. We attended all the hearings and Mr. Palmer, at least, made some excellent points. With the adjournment of the Committee for a week at a time and their short hearings of an hour each week, the rapacity of Washington hotel keepers, soon reduced our slender appropriations. A council of war was held. Mr. Palmer decided he must go home. I determined to stay. All spare time was employed in the Congressional Library in the exanina-

tion of law, for the constitutional point seemed to be the best and strongest. Practically, I was alone. The Fish Commissioner of my own State had gone home and I was informed that there was nothing of the appropriation of $14,000 which was available for the purpose of resisting this bill, even to the extent of paying for printing an argument. I was not in funds myself for the purpose.

At this juncture something of an inspiration came to me. I remember that at one of the hearings before a packed and adverse Committee of our Massachusetts Legislature on Fisheries and Game, I had seen a Fish Commissioner for the State of Maine, Doctor Edwin W. Gould, who seemed somehow to have the idea firmly rooted in his mind, that it was part of the duty of a Fish Commissioner to preserve fish as well as propagate them. I telegraphed for him. I told him that matters were critical. He notified me to hold on and he would come on. He did so and personally I felt the situation change. He brought to the work energy, determination, an official position and some little money. The Doctor is a physician in active practice; yet for almost three consecutive weeks he staid on in Washington. The days were spent in the Congressional Library, I working on the legal, he on the scientific aspects of the question. Evenings and Sundays were spent at his hotel. The headquarters of the "Fisheries Defence" were Room 8, Hotel Hamilton, Washington, D. C., for weeks. A brief on the law and a memorial of facts were prepared, printed at the expense of the State of Maine, submitted to Congress and distributed through the country. We desired to visit certain places on the coast, New Jersey, Virginia or Maryland, to enlist support we were sure to find, but the funds were not sufficient. What could be done in other States through the mails we did, and valuable results followed, as we have ventured to hope. From this or other causes, representatives began to hear

from their constituents hitherto silent. The Massachusetts Legislature sent on the Attorney General and an agent, both of whom were to act without compensation and rely for their expenses upon the capacity of the contingent fund.

The Attorney General of Maine consequently addressed the Committee against the bill. By these and other influences, the bill met its fate.

The "Lapham Bill" will have served a most useful purpose if it emphasizes the danger to the fisheries from this quarter and suggests the remedy for their protection. The danger is in those opposing disciplined troops of gorilla warfare; the remedy is in the hands of admirable organizations such as yours, and lies in solidifying the interests of the country for the preservation of its fish supply of food.